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MANUAL OF FIREMANSHIP

A SURVEY OF THE
SCIENCE OF FIREFIGHTING

PART 6A
PRACTICAL FIREMANSHIP—I

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PRACTICAL FIREFIGHTING

A fireman, to be successful, must enter buildings ; he must get in below, above, on every side, from opposite houses, over back walls, over side walls, through panels of doors, through windows, through loop holes, through skylights, through holes cut by himself in the gates, the walls, the roof ; he must know how to reach the attic from the basement by ladders placed on half burned stairs, and the basement from the attic by rope made fast on a chimney. His whole success depends on his getting in and remaining there and he must always carry his appliances with him, as without them he is of no use.

So wrote Sir Eyre Massey Shaw in his book, Fires and Fire Brigades. These words, though penned nearly eighty years ago, are as true now as on the day they were written.

IN this chapter it is proposed to survey the knowledge required by the individual member of the crew if he is to perform his duties as a fireman at a fire, and the term " officer " or " officer in charge " has been commonly used to denote the man who is in charge of the crew, irrespective of his rank. An endeavour will be made to treat the subject in the sequence in which action usually takes place in dealing with a fire, although by no means all the information dealt with below will be required at any single outbreak and the order in which the various steps are taken will not necessarily follow that adopted here.

PRELIMINARY

" No two fires are alike," is an old and very true Fire Service saying, and therefore technical knowledge must be backed up by intelligence and the ability to grasp the fundamentals of a situation, to initiate a plan of action and to improvise on the spur of the moment.

1. THE FIREMAN

The fireman must be physically fit, for work at a fire will almost always involve great physical exertion. He must be courageous and yet be calm, for on these qualities will depend his reactions in an emergency. He must be patient, for often he will need patience when dealing with persons whose property is involved or threatened by fire and who are in a state of considerable mental distress. He must have initiative and yet possess the will to keep going for long periods under adverse conditions. He must cultivate his powers of observation to the utmost and must also possess an enquiring mind. He must have a keen sense of discipline, for unless he himself is able to obey orders without question he cannot expect others to carry out his orders. Finally, he must never forget that as a member of the Fire Service he is a servant of the public, and that it is to him that the public turns in an emergency. His duty

may be summed up as, firstly, to save life, secondly, to prevent the destruction of property by fire and, thirdly, to render humanitarian services.

The fireman who wishes to progress in his profession should study every outbreak which he has the good fortune to attend and endeavour to learn something from it. Thus, after a few years, he will have built up a store of practical knowledge which will equip him for dealing with most of the problems which come his way.

2. BEFORE THE FIRE

(a) *Study of Station's Ground.* An intensive study of the station's ground is the first requisite for successful firefighting, the knowledge gained growing with time and with attendance at fires on the ground. Every fireman, and especially the officer in charge of the station, should know all the more important details, such as hydrants and the lay-out and capacity of the mains, etc., and whether, by previous arrangement with the water undertaking, the supplies or pressure can be increased in any particular district. He should be familiar with the position of all supplementary water supplies which would be of any account in firefighting, both in cities and in rural areas.

He should have detailed information regarding the theatres, cinemas and places of public entertainment, and the hospitals, institutions, etc., where numbers of people will be sleeping at night. He should know which buildings are sprinklered, and which have a metered supply on which a by-pass must be operated to feed internal hydrants. He should be aware of buildings which have electric substations; of the whereabouts of foam inlets, dry risers, drenchers (noting whether these are automatic or hand-operated and whether fitted with Fire Service inlets), and of all other aids to fighting a fire. In particular, he should endeavour to learn as much as possible of any special manufacturing processes or industries carried on, so that if he is called to a fire on the premises, he will be aware of the conditions he will meet, and of any precautions he must take.

Enquiries previous to a fire will tell him whether or not the Police or other persons hold keys to certain classes of premises. In some localities, indeed, it is the practice for keys of certain premises and also of park gates, public buildings, etc., to be held in the station watchroom (see p. 129).

He must also make local contacts with appropriate individuals, such as the occupiers of large premises and the officers in charge of industrial or private fire brigades, for good liaison with them will produce that effective co-operation which is essential for smooth working should the Fire Service be called to a fire on their premises.

He should be aware of telephone facilities on his station's ground, and a knowledge of alternative means of communication will be essential.

In rural areas he must not only know the whereabouts of all the more important water supplies and the best way of reaching them, but he must also remember whether or not they are likely to dry up in the summer or autumn, or be unapproachable in the winter

because of mud. He must know if suitable streams exist and how they can be dammed and be able to estimate roughly how much water they will yield him. It will greatly assist, too, if he is aware of the various farm tracks and to what extent they can be used to reach isolated farmsteads, whilst in winter he will keep himself posted, as far as possible, regarding changes in road conditions due to the weather.

In some localities, level crossings, toll bridges and swing bridges may cause considerable delays. Prior contact with railway officials or the bridge authority will disclose how far it may be possible to prevent such delays. Also of importance will be a knowledge of any tunnels and the times of sailing of any ferries which can be used.

(b) *Station Organisation.* At the station, it is part of the duty of a fireman to maintain his appliances in a high state of preparedness; he must not overlook the less obvious details, such as the sharpening of cold chisels, saws, axes, etc., together with the inspection and testing of the small items of gear which are but rarely used. Regular inspection, testing and cleaning help to build up confidence in the equipment and ensure a thorough knowledge of where all the various items of gear are stowed on the appliance. This should be checked by periodical drills in the dark, and by sending men for particular items of equipment in order to ensure, not only that they know what each item is, but where it can be found on the appliance, so that it can be got without delay.

Such personal equipment as is not being worn should be stowed neatly in a standardised manner on the vehicle so that it may be put on with the least delay. The most satisfactory method is to arrange it in the order of dressing, with the last garment to be donned at the bottom of the pile. At night, boots should be kept by the bed or trestle, with leggings in place on them, and tunics and other fire gear on the appliance. If it is not possible to leave kit in this way (because of lack of space on the appliance or because it must stand in the open) it should be hung on pegs or otherwise suitably arranged where it can be reached without confusion.

(c) *Taking over an Appliance.* Crews should always be fallen in and detailed as riders on coming on duty. In addition, at most stations, a riders' board showing this information at a glance is maintained by the watchroom staff, and this is a useful plan to follow.

When taking over an appliance at the beginning of a tour of duty the officer must not forget that he is responsible for the appliance being roadworthy and that both it and the equipment are ready for any calls which may be made upon them. He may wish to check these for himself or, alternatively, may delegate the duty to the driver, but, having satisfied himself that everything is in position, it is he that must report to the officer in charge of the station that his appliance is complete and available.

During this check, attention should be paid to such matters as whether standpipe and suction washers are in position, whether, in the case of ball hydrant standpipes, the cup is fully withdrawn into

the standpipe, so that it will not foul the hydrant when it is being shipped, and whether, in the case of lugged standpipes, the lug is fully screwed down. Particular attention should also be paid to hand-controlled and diffuser branches to see that they operate freely.

The checking of the appliance will include verifying that oil, petrol and water levels are correct, and that the hose reel tank (if fitted) is full.

3. THE TURN-OUT

(a) *First Attendance.* The number of appliances which will answer a fire call on a first attendance will vary considerably with the nature of the fire risk in the area. In most urban localities the minimum attendance will be one escape-carrying appliance and one pump, the former, as a life-saving appliance, being the first away. In the highest risk areas, the first attendance may be as much as six appliances, which would include a turntable ladder. In some cities it is customary to drop the last appliance by day.

To facilitate description in this chapter, the first appliance away, which will be that on which the main burden of any rescue operations will fall, is termed the first appliance. It will be appreciated that this appliance may be an escape, or sometimes a pump with long extension ladder.

The time taken to turn out will, of course, depend greatly upon the conditions obtaining at the station, but, whatever the conditions, too much emphasis cannot be laid on the necessity for the greatest possible speed in getting the first appliance away. Where the first appliance crew rests at night partially dressed within easy reach of the appliance, then a turn-out time of twenty seconds may be considered reasonably good. Men should complete dressing in their fire kit on the way to the fire, but the aim must always be to arrive at the call fully dressed. If the call is to an address close to the station, it may be wise to complete dressing before the appliance turns out.

If only one appliance turns out from the station then the officer in charge will ride on it, but if there is more than one, then the turn-out of the first appliance should not be delayed to wait for a resident officer. Normally he will respond by the second appliance or in a fire car.

All large fires grow out of small beginnings, so that, apart from the promptitude or otherwise of the call, whether or not the fire is extinguished with but little damage or gets away completely will depend almost entirely on the skill, initiative and resource of the officer in charge and the crews of the first appliances to arrive.

(b) *The Address of the Fire.* The driver must be sure not only that he knows *before* he leaves the station the address to which he is called, but also the way to it. Where there is any possibility of confusion, as for example, where the same name is used for a street and a square or avenue, time is saved and accuracy ensured if the address is written down in the watchroom and the slip of paper handed to the officer in charge of the appliance. It is always wise, in the case of a call to anything but a fire alarm, to get a subsidiary

landmark such as "10, High Street, opposite Palace Cinema" or "25, Green Lane, off Market Hill."

All members of the crew should make as little noise as possible during the turn-out, as it will then be possible for everyone to hear the address of the call. If each man knows his position on the appliance and where his gear is, there should be no need for anyone but the officer in charge to speak. In many modern stations the address of the fire can be announced from the watchroom through a loud speaker. With some fire alarm systems the number of the box which has been operated is shown in an illuminated panel above the appliance room doors. Automatic systems should not, however, be relied upon as the only means of notification; written or spoken indication should also be given as a precaution against mechanical failure. If the lay-out of the station permits, the dutyman (*i.e.*, the man on duty in the watchroom (see the Chapter on "Watchrooms and Control Rooms")) should hand the address to the officer in charge; he can then give him any additional information he may have about the call.

Except in those stations where the doors are opened automatically from the watchroom, the doors of the station should not be opened until the appliance is ready to move off. If the doors are opened before the appliances are ready to move off, there is a strong probability that members of the public will collect on the forecourt to watch and will cause an obstruction.

4. PROCEEDING TO A FIRE

(a) *Traffic Regulations.* The officer in charge of a fire appliance should never forget that in law it is the driver of the vehicle who is responsible for its safe passage along the public highway. In this country there is no exemption from traffic regulations for drivers of fire appliances, except that under the Road Traffic Act, 1934 (Section 3), a fire appliance proceeding to a fire is exempt from the speed limit, and it is permissible to use a gong, bell or siren.

Notwithstanding that a driver on his way to a fire is authorised to exceed the speed limit, it is essential that he should drive with caution and consideration and remember the old Fire Service maxim, "It is better to be safe than sorry." The great proportion of the traffic he encounters will be sympathetic towards him and will endeavour to facilitate his passage.

It is true that "only one man at a time can drive an appliance," yet the experienced officer in charge can exercise a steadying influence on the driver and give him greater confidence. For instance, he may indicate, preferably with a sign of the hand, that he is driving too fast for safety. The officer in charge should never take up the attitude that he has no control over, or responsibility for, the actions of his driver nor should he ever use an expression such as "step on it" which might be likely to excite an inexperienced driver and lead him to be rash.

If a driver has been at fault, it will often be best for the officer in charge of the appliance to leave any criticism until the driver has

returned to the station, when he can be seen quietly and dispassionately in an office and his driving errors pointed out to him. It must always be borne in mind that it is the duty of an officer to train his drivers.

Two points which are perhaps worth recording are as follows :—

(i) Particularly when nearing the fire, drivers of fire appliances should bear in mind that other fire appliances are likely to be converging on the fire and may even be seeking an opportunity to “jump” the traffic lights. Unfortunately, collisions between appliances on the way to the same fire are not unknown.

(ii) Signals by pedestrians indicating that a crossing is safe should be disregarded or, if accepted, treated with the greatest reserve.

(b) The Firebell. The firebell of an appliance not only serves to warn traffic on the road that a fire appliance is proceeding to a fire, but also serves to advise persons who may be awaiting rescue under extreme nervous distress that help is on the way, and may serve to give them strength to hold on for those extra moments until the appliance arrives. The bell should be rung vigorously but in short sharp bursts with a distinct pause between bursts. It will then be possible to hear the bells of other fire appliances which may be converging towards the call along other roads. If, for any reason, the appliance is not fitted with a bell, or if the bell is out of order, the vehicle should not be driven faster than would be safe for ordinary traffic.

The ringing of the bell should be continued at a crossing. There is frequently a tendency to stop ringing, since the ringer of the bell is preoccupied with the thought of what traffic he may meet. Discretion should be used in ringing the bell when approaching horses, since animals have been known to bolt through this cause. If called to a hospital, theatre, cinema or other building where the public are likely to be gathered in numbers, ringing should cease in ample time before arriving, so as to avoid alarming those in the building.

Inexperienced drivers of appliances occasionally become excited at the sound of the bell, and the more insistently the bell is rung the faster they drive. As the bell is rung more vigorously when a traffic jam is looming, this tendency must be carefully guarded against.

It goes without saying that the firebell of an appliance should only be rung when responding to a call. It is not permissible to ring the bell when returning from a fire or when on exercises. On such occasions all traffic regulations should be complied with.

(c) Road Accidents. If an appliance is involved in a minor collision whilst responding to a call but is still roadworthy, subject to any directions given by the Police, it will be sufficient if a man is left behind to take the necessary particulars whilst the appliance proceeds. If the first appliance attending is involved in a serious accident which results in injury or death, again subject to any directions given by the Police it will usually be desirable to proceed after stopping, but steps must of course first be taken to minimise

the distress caused. A member of the crew should be dropped off the appliance with the first aid box, an ambulance should be ordered and the mobilising control notified of the accident.

Before the appliance proceeds on its way, its position at the time of the accident should be marked by chipping the surface of the road with an axe. In the event of a serious accident of this nature, the Police can do much to assist the crew of the appliance and relieve them of anxiety. Immediately on returning to the station after dealing with the fire, arrangements should be made for the brakes of the appliance to be tested by a competent authority.

It should be remembered that although a person may have been injured or even killed in a road accident, the lives of a number of persons imperilled by fire may be dependent on the rapid arrival of an appliance equipped for rescue work.

If, for any reason, it is impossible for the appliance to proceed, or if serious delay is probable, the first action must be to get a message back to the appropriate control, so that a substitute appliance can be ordered on. This is of particular importance in the case of an appliance which may be required for rescue purposes.

(d) *Punctures.* If the tyre of an appliance is punctured on the way to a fire and the distance is not too great, the vehicle should proceed at reduced speed. If the distance is considerable, it will be desirable to stop to change the wheel, and at the same time a message should be sent back to the control for another appliance to be ordered on, unless it is known with reasonable certainty that, owing to the distance another appliance would have to travel, the affected appliance would arrive first. Should the first appliance be immobilised close to the fire, the escape or the extension ladder should be slipped and wheeled or carried to the fire. On appliances fitted with twin rear wheels a puncture in one of the twin wheels need not, of course, delay the appliance.

(e) *Advance Planning en route.* On the way to a fire, the officer should always remind himself of the various things he will have to do and think of when he arrives. For example, the whereabouts of the nearest hydrant and open water supplies, whether and where a telephone will be available by which to send a message back to the station, and what sort of property forms the area to which he is called and whether or not there is likely to be an extensive rescue job—for example, if the call is to a building frequented by the public, such as a hotel, large store with staff sleeping on the upper floors, hospital, theatre, etc., it may involve a request for additional escapes, or turntable ladders, to be sent on.

5. ARRIVAL

(a) *Calls by Fire Alarm.* If the call originates from a street fire alarm, not of a type where the address of the fire is given over a telephone, there should be a member of the public awaiting the arrival of the appliance. If he is not immediately identifiable, a careful watch should be kept in the immediate vicinity, as the caller in his excitement may have run back to the fire, not

realising that the appliances will require directing to the address of the fire.

If the alarm is unattended and there appears to be nobody about, (circumstances which point to a malicious call) the appliance should draw up and reasonable time should be allowed in case the person who operated the alarm should return. If, as will normally be the case, more than one appliance attends, the pump or second appliance should make a short tour of the adjacent streets for any signs of the fire, ringing the firebell periodically and leaving an appliance waiting at the fire alarm. It should always be remembered that some persons, in their excitement, are apt to operate the alarm and then return to the fire, failing to follow the instruction to await the arrival of the appliances. Fire alarms are sometimes operated by persons who see a distant glow in the sky. If on arrival the glow of a fire can be seen but its location is not obvious, the station should be telephoned for instructions. This will also be necessary if it is found that the wrong fire alarm has been attended (which will be obvious from the fact that the glass is unbroken).

On arriving at a fire alarm it should not be forgotten that if the person who has operated the alarm is picked up and the appliance proceeds straight to the fire, those following may be left without details of the fire call or knowledge of its whereabouts. If the location of the fire is not obvious and it is necessary to take the caller with the appliance, arrangements should be made for someone to give the following appliances the address of the call. If the fire alarms are widely separated, and there is thus a possibility that the call is to an address some distance from the alarm, a slip of paper with the address written on it may be left in the fire alarm head.

An appliance responding to a fire alarm call should not pass the fire on the way to the box if the fire is visible. In such a case, however, a member of the crew must be sent to the alarm to verify that the fire which is being attended is that for which the alarm was operated.

(b) Calls by Telephone. If the call is to an address given over the telephone, and on arrival no trace of fire is found, the station should be telephoned for further details of the call. In large premises which abut on to more than one road, it should be remembered that the address giver may not be that by which the premises are usually known, and, therefore, if no persons are present at the door at which the first arrival is made, search should be made for an alternative entrance. If the call is to a building in which members of the public are present, appropriate steps to prevent panic must always be borne in mind. These are dealt with in the Chapter on "Special and Unusual Risks."

(c) Locating Hydrants. If the call is to a definite address then, on approaching, all members of the crew should be on the lookout, firstly, for signs of fire and, secondly, for the most suitable hydrant or other water supply. Hydrants should be clearly identifiable by the hydrant plates, which should show the size of the main. If a

hydrant cannot immediately be located, the man with the standpipe should search in the direction of the nearest main road.

(d) Whereabouts of Fire. If, on arrival at the address of the call, the whereabouts of the fire is not immediately obvious, one of the occupants may be able to act as guide. If not, the fireman will have to locate the fire for himself. The various clues which he can use to assist him are described later.

(e) Slipping the Escape. Immediately on pulling up in front of the building, if an escape-carrying appliance is being employed, the officer in charge should consider whether to slip the escape (see Part 2, p. 100). Slipping the escape will ensure that, even though it is not immediately required, the escape is at the fire in case it is wanted later in the operations, for it may subsequently be necessary to move the appliance so that it can be set in to a water supply. In the case of a pump escape with a rear mounted pump, it may also be essential to slip the escape in order to get at the pump to operate it. When an escape is slipped in this way it should be left in a safe position, out of the way of traffic.

(f) Responsibility of First Officer. The immediate task of the officer in charge of the first appliance to arrive is to carry out any necessary rescues. For this he must ascertain whether or not persons are in the building and, if so, exactly where they are or, if that is not known, where they were last seen. Beyond this, it will be necessary to survey the situation, entering the premises if at all possible, to decide from which points the fire should be attacked and to assess the appliances required to deal with it.

It should be clearly understood that this responsibility continues until the officer in charge is relieved by an officer senior to him, when there must be a definite handing over of authority which will, of course, be accompanied by a brief verbal report on the situation and the steps taken to deal with it. The senior officer arriving at a small fire will usually find the officer in charge inside the building and will, if necessary, make contact with him there, for his junior will be fully occupied handling the fire situation.

(g) Further Appliances Arriving. Where two or more appliances attend a first call, the officers in charge of all appliances after the first to arrive should always, except in very unusual circumstances, report to the officer in charge of the fire and get instructions. In the rare event of there being an obvious rescue waiting to be carried out, they would, of course, get to work without prior instructions and would report afterwards what they had done.

It is essential that the officers of all appliances attending should report at the earliest practicable moment and that they should not, except in the most unusual circumstances, get to work without instructions from the officer in charge of the fire, since he will already have decided on his plan of action and will be relying on the arrival of assistance to put it into execution. An officer reporting should take one man with him to act as a messenger, leaving his crew standing by the appliance ready for orders. The messenger can then take back his orders to the crew whilst the officer awaits his crew at the point where they are to get to work.

(h) *Sprinklered Buildings.* In his preliminary size-up of the outside of the premises the officer will note whether the building is sprinklered, drenchered or is fitted with inlets to dry risers. Well trained personnel will be thoroughly familiar with all the premises on the ground covered by their station which are so equipped, but reinforcing crews will have to rely on observation. The presence of a sprinkler gong and of the sprinkler stop valve notice will give an indication from the outside. It will then be necessary to detail a member of the crew to stand by the main stop valve to see that it is open, with instructions not to close it until ordered to do so by the officer in charge of the fire.

If, however, it is only when inside the building that the officer finds it to be sprinklered, then it will usually be quicker to go outside again and double round it until the stop valve notice is located, rather than to try and find the stop valve from within. If no obvious sign of fire can be found, a thorough search of the building should be made, since the alarm may have been caused by the operation of a defective sprinkler head or through some other defect such as a fractured water pipe. (For the subject generally see the Chapter on "Sprinklers, etc.")

(i) *Automatic Fire Alarms.* If the call is to a building fitted with automatic fire alarms, the recording panel will give an indication of the location of the fire. If no fire is found at the point indicated, all floors should be searched as a precaution, in case the wrong flap has dropped. Equally, if no flap has dropped but the alarm has functioned, the building should be searched. In either case a message to the effect that the fire is not yet located and that a search is in progress should be sent back to the mobilising control. (For the subject generally see the Chapter on "Automatic and Manually-operated Fire Alarms.")

(j) *Equipment Required on Entry.* A cardinal rule in firefighting is never to enter a building empty-handed, and thought should therefore be given to the items of equipment which will be necessary to deal with the fire. The officer in charge will, of course, normally give instructions to the various members of the crew regarding the equipment to be taken into the building. If the location of the fire is not obvious, however, he will probably prefer to reconnoitre, accompanied by one man carrying suitable equipment.

The gear to be taken in will obviously depend on circumstances, but very often (apart from the hand lamp which should form part of the personal equipment), it will comprise a large axe and, unless the fire is visible from the street, a chemical extinguisher. A long line carried pack fashion (see Chapter 39) may also be found useful. When using an escape to enter a smoke-logged room or compartment, the escape line, which is permanently secured to the head iron on some escapes, should always be taken in. This will enable the man to find his way back to the head of the escape.

(k) *The Hose Reel.* A large proportion of fires in domestic and many other types of property can be dealt with by means of the hose reel equipment and, unless the outbreak is obviously beyond the extinguishing capacities of this method, hose reel tubing (if

the appliance carries it) will ordinarily be taken into the building on first entry. The first action of the pump operator will, therefore, be to engage the hose reel pump and charge the hose reel. Immediate steps will then be taken to connect up a line of hose from the nearest hydrant in order to maintain the supply of water to the hose reel tank (see Part 2, p. 35).

Although under normal circumstances the hose reel, or the first line of hose as the case may be, is got to work up the staircase, it may save time, on arriving at a high building where the outbreak is found to be on an upper floor, to take a line, proceed to the highest window below the fire by the stairs and drop one end of the line down to the street. This can be secured to the hose reel tubing, or any other item of gear required, by the remaining member or members of the crew and hauled up the face of the building. If hose reel tubing is taken up the staircase, much time is wasted and, owing to the considerable extra distance which must be traversed, the tubing may prove too short to reach the site of the fire. It is, of course, obvious that where entrance is made from a ladder or an escape the hose reel tubing will be taken up the ladder.

(1) *Setting In to Hydrants.* In order to prevent accidents to vehicles or to passers-by falling into the open hydrant pit, it is always desirable, where the construction of the hydrant permits, after opening up, to place the cover at an angle across the pit. Open hydrant pits, if left unattended at night, should have a lamp beside them. Before shipping the standpipe, the hydrant valve should be turned on to flush the hydrant and remove any foreign matter which may have collected in the outlet. Once the hydrant is ready to get to work, hose lines need only be laid if it is obvious that they may be wanted. *A hydrant should always be opened up in this way even though the outbreak is believed to be small*, except when it is obvious that only hand equipment will be required. It enables a full-sized line of hose to be got to work immediately if the outbreak is more serious than was at first believed and, if it is then necessary to use the main pump, the hose line can be connected up to the suction inlet by means of a suction adaptor and the pump got to work. The next appliance to arrive can then be sent to the nearest available hydrant and hose lines laid out as necessary.

In areas where the pressure in the mains is good, it may not be necessary to set a pump in to the hydrant, the hose line being connected direct to the standpipe. But unless it is obvious that the fire can be successfully tackled with the jet which will be furnished by the hydrant, it is sound practice to set a pump in to the hydrant and connect up the hose line to one of the deliveries. This method has the advantage that the pump can be used to adjust the pressure as required by firefighting operations, and that additional hose lines can be connected to the spare deliveries without the necessity for shutting down the line or lines at work. A further advantage, in the case of pumps fitted with divided suction inlets, is that suction can be connected from a hydrant to one inlet and the collecting head to the other. Thus, if the hydrant

capacity is insufficient, other hydrants on mains having a greater capacity can be used to feed into the collecting head.

With pumps having only one inlet, if the hard suction is connected direct from hydrant to suction inlet there is no other means of supplementing the water supply. The alternative is to connect the hard suction by an adaptor to one of the inlets of the collecting head, which gives rise to considerable friction losses due to the restriction of the waterway by the non-return valve. It is preferable, therefore, to couple up a collecting head to the pump inlet and employ a suitable number of lines of soft suction. It should not be overlooked that, if the mains pressure is reasonable, it is not essential for the pump to be running to obtain a jet at the branch.

FIGHTING THE FIRE

Having completed the initial outside examination which will, of course, be carried out more or less as the appliance draws up, the next essential is to enter the building in order to carry out any necessary rescues and to check the spread of fire by attack *at the closest possible quarters*. The methods of obtaining an entry are dealt with in Chapter 35.

I. WORKING IN SMOKE OR DARKNESS

(a) *Electrical Circuits.* Once the fireman has entered the building one of his chief difficulties will be his inability to see, if the premises are in darkness or if thick smoke is encountered. It will then be necessary to decide whether, if the electricity supply is on, it should be switched off at the main, or whether, if it is already off, it should be switched on. (For the subject of electricity generally, see the Chapter on "Electricity and the Fire Service.")

In this the Fire Service officer will have to be guided by the circumstances of the case, the general principles being that the lights should always be used unless any definite danger would accrue to firemen working in the building, as they will facilitate movement about the building and save the fireman much time. On the other hand, if the building is seriously damaged by fire and there is a chance that the electric wiring may have fallen out of place, the current should be cut off in order to obviate the danger of firemen coming into contact with exposed wiring. In buildings used by the public, however, it will be necessary, irrespective of the conditions, to leave the current on until all occupants have been cleared, since switching off in such circumstances might trap persons in lifts or, if the lights went out suddenly, lead to panic. Any power circuits should be switched off irrespective of the conditions unless it would interfere with the working of lifts, since such circuits are often at a higher voltage and are therefore correspondingly more dangerous.

If, contrary to expectations, it is found that the current is switched off at the main, enquiries should be made before it is switched on

again, to make sure that it has not been cut off because of some defect or because persons are working on machinery. A main switch should always be examined before it is operated, for the design varies greatly and it is not unknown for the current unwittingly to be turned "on" instead of "off," or *vice versa*.

If the building lights cannot be used, then Fire Service emergency lighting will be essential. Hand lamps will be employed when it is necessary to move about the premises, but if prolonged lighting of the various floors is required, box lamps or the various types of portable floodlights should be employed. It need hardly be added that naked lights of any type must not be used if explosive or inflammable gases or vapours are likely to be encountered. Box lamps, etc., are particularly useful for illuminating stairs or landings, and are often put at doorways where they will throw their light in both directions and also serve to indicate the whereabouts of the exit.

(b) *Use of Breathing Apparatus.* If the smoke is too thick to work in, breathing apparatus will save the fireman much unnecessary punishment, and will often make it easier and quicker to find the fire. Certain types of smoke such as that given off by burning electrical insulation are so penetrating that the use of breathing apparatus may be almost essential. At fires in buildings where poisonous chemicals may be found, or where certain types of industrial processes are carried on, breathing apparatus will be required owing to the presence of dangerous fumes.

(c) *Moving in Smoke.* Whether wearing breathing apparatus or not, men should always work in pairs in thick smoke as this not only promotes confidence but makes it possible for one man to assist the other in case of difficulty. When in strange surroundings and unable to see, the only course is to work by touch. In such circumstances the necessity for caution is obvious and much can be done to reduce the possibility of accident by attention to a few simple points. The first of these is to shuffle—not walk. The weight of the body should be kept poised on the rear foot until the advancing foot has tested that it is safe to move forward and the feet should not be lifted from the ground—they should slide forward as this will help to detect obstructions and dangers such as projecting nails, etc., which might pierce the boots and injure the feet.

In smoke, the air will be coolest near the floor, and the fireman will usually find it desirable to go down on hands and knees. As he moves forward he should raise his free hand in front of him lightly clenched, with the back uppermost, to feel for obstructions. If the back of the hand then touches a live electric wire the shock will throw it clear and will not cause the hand to grasp the wire, as would occur were the hand open. It will often be possible to detect from this position the glow of a fire which cannot be seen when standing upright. Where, however, there is a risk of encountering dangerous fumes (such, for instance, as those of nitric or hydrochloric acids used in process engraving or electro-plating works) which are heavier than air and therefore accumulate near the floor, then a

stooping or crawling position should not be adopted. These fumes will usually be detectable by smell, if the fireman is not already aware of the presence of the hazardous commodities in the building.

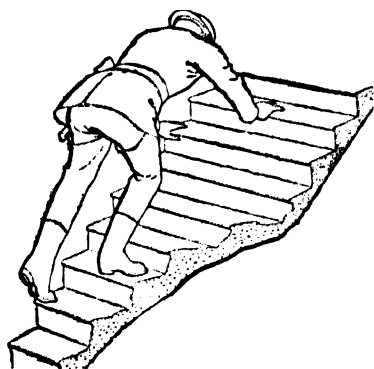


Fig. 1. Suggested method of moving backwards downstairs towards a fire in a basement.

When it is dark, or where there is much heat and smoke, it is better to proceed backwards downstairs towards a basement fire, since this renders breathing easier and shields the face from heat. This method has the additional advantage (Fig. 1) that the stairs can be grasped with the hands, so preventing a fall in case of accident. On the other hand, some firemen prefer to move downstairs in thick smoke in a sitting position with head well back close to the stairs. In this way the feet can be used to feel for the stair ahead before the weight is transferred to it.

When first entering a smoky building it is unwise to mount the stairs too quickly. Under such conditions it is easy to become out of breath and recovery is then rarely possible without going out into the fresh air again. It will be found that the air is cooler and fresher near the floor or close to the branch, if one is in use, and it is always wise to breathe through the nose, as this acts as a filter to the air and removes many of the small particles of carbon, etc., which would otherwise be inhaled. Actions should throughout be as easy and effortless as possible, in order to reduce the amount of air and hence the amount of smoke which is drawn into the lungs. A man working in a roof void may be able to poke out from the inside a couple of slates and so get a breath of fresh air.

The fireman should not remain in severe smoke after he feels himself incapable of performing any further useful work, as he will only become a casualty and other members of the crew may have to leave their work to assist him out. Symptoms of impending collapse are difficult to describe, but are frequently said to produce a feeling of "becoming light." A fireman can often obtain an indication of working conditions, for a fire which is burning brightly is always safe because it indicates that plenty of air is present, whereas a murky smoky flame may signify a lack of oxygen.

Wet face cloths, wet sponges, etc., which are sometimes used by firemen, remove some of the larger particles when smoky air is inhaled, but give no protection against asphyxiation from oxygen deficiency or excess of carbon dioxide, or poisoning from excess of carbon monoxide, and accordingly tend to give a false sense of security. Their use is not recommended. Face cloths, however, are sometimes desirable when working in fumes that affect the skin.

(d) *If Lost in Smoke.* The possibility of getting lost in a smoky building must always be borne in mind, and a mental note should be made of any features which will assist in retracing the route to safety. A man can always find his way to safety by retracing a hose line which has been taken into a building by keeping it between the feet, but it should not be forgotten that it may run over the edge of a flat roof or out of a window or loophole far above ground level. (A loophole (see p. 125) is an opening above ground level through which goods can be loaded into, or unloaded from, a building by means of a rope and pulley or a crane.) The branchman can always be found by following up the appropriate hose line.

In large public halls, etc., it may often be possible to feel the run of the floorboards and so keep in one direction by following them along by touch. If a man is lost in a room he should make for a wall and then continue round it in the same direction until the door or a window is reached. Sounds from outside can often prove a guide as to the whereabouts of an exit. If it is suspected that a man is lost in smoke it may sometimes be possible to indicate to him the whereabouts of the way out by standing close to it and blowing periodical short sharp blasts on a whistle. Many firemen carry a whistle for use in an emergency, since the sound carries far better than the human voice and needs less effort to produce.

On certain floors in some buildings (particularly the basements of large stores) there may be a central staircase only. If a circuit of the walls has been made without a way out being found, the centre should be explored. In thick smoke, mirrors may look like windows or may reflect the fire, whilst showcases may also in some instances give the same impression.

2. FINDING THE FIRE

The whereabouts of a fire will frequently be obvious, but the fireman will often attend calls when it will require all his ingenuity and resource to track down the seat of the fire without causing damage out of all proportion to the size of the outbreak.

Finding the fire then becomes a question of elimination, and pertinacity and a highly developed detective instinct are necessary. In such circumstances he must proceed systematically. In some cases, for example in terraced houses having a common roof void, the first step must be to discover which is the particular building affected. It is obviously important to be sure about the house if it should be necessary to break in to get at the fire.

(a) *External Indications.* There may be indications visible from the outside, such as smoke emerging from some part of the building (though this is by no means a certain guide), the sound of crackling or the discoloration of window glass. At night, or if the curtains are drawn, the windows may be felt for heat with the palm of the hand, and the letter box flap lifted to test whether smoke can be detected by smell.

Once the necessary entrance has been effected, the next step will be to track down the fire itself, in which an understanding of

the principles of smoke travel will be one of the most important aids.

(b) *Smoke Travel.* It has already been stated that, whilst visible flame will be a definite indication, the issue of smoke from any part of a building, whilst denoting the existence of fire, does not necessarily imply that the part from which the smoke is issuing is that affected. This is because smoke can travel for considerable distances from the source of the outbreak by reason of air currents, etc. Neither is it a fact that the volume of smoke is a true guide to the size of the outbreak.

Small fires which have been "bottled up" for some hours may give rise to large quantities of smoke, and it is well known that various materials will give off very different quantities of smoke, even when burning under the same conditions. The type of smoke may often form a valuable guide as to the nature of the burning material, while that from certain substances such as wood, soot, rubber, etc., has a very characteristic smell.

(i) *Mushrooming.* It is a characteristic of smoke that when heated it will tend to rise, owing to its lesser density as compared with air, but as it cools so the density increases, until the heavier particles of which it is composed tend to sink again. Thus, near the fire there is a definite upward tendency which drives the smoke up lift shafts, staircases, light wells, etc., and in fact any vertical openings which are in communication with the compartment in which the fire has occurred. The smoke will rise more or less vertically until it strikes a roof or ceiling, when it will spread sideways. This is the so-called "mushrooming," which may be responsible for a great deal of damage if overhead venting of the fire cannot be effected (see Chapter 37).

In high modern buildings the staircases and lift shafts allow smoke to rise from basement to roof where, unless it can escape, it will mushroom out on the top floor. If, however, the smoke encounters an obstruction such as a stationary lift in the shaft at an intermediate floor, it will mushroom out at this level, instead of rising to the top, and if no fire doors are fitted to the shaft, or if, as is often the case, they have been wedged open, the intermediate floor or floors will become smoke-logged. Open or badly fitting doors or transom lights in internal partitions will also allow smoke to diffuse over a wide area.

(ii) *Influence of Air Currents.* It should be appreciated that anything which will cause air currents in the building will assist in the spread of smoke. The effect of ventilation ducts in large buildings should not be overlooked, for smoke may be drawn into them and discharged far from the fire or, if a plenum system (see the Chapter on "Building Construction") is in use, the excess air in the neighbourhood of the fire will tend to drive the smoke into the most unlikely places.

In tracing the travel of smoke, the type and construction of the building will prove a useful guide. Thus, hollow partitions and lightweight construction may have communicating cavities over considerable distances and may carry the smoke far from the fire.

In old office premises which have often been altered and subdivided, there may be numerous partitions either going up to the ceiling or terminating at 7 or 8 ft. above the floor, which may greatly confuse the fireman by the influence they will have on smoke travel.

In buildings having panelled walls smoke travel may be particularly difficult to trace, and such buildings present a serious hazard on account of the concealed spaces behind the panelling, and the way in which heat and flame can travel along them unseen. Again, the cavity in a mansard roof will allow smoke to travel for considerable distances from the seat of the fire, and lead to its appearance in the most unexpected places. Roof voids and basements common to more than one house may also assist in fire or smoke travel, as will defective brickwork.

Sometimes at night when only a smell of smoke can be detected it may be wise to turn off all lights in a room, even throughout the building, and use the beam from an electric torch, which will often show up a wisp of smoke which would not otherwise be seen. The smoke can then be followed to its source in the same way.

(iii) *Misleading Evidence.* Great care must be taken, however, not to be misled by the appearance of smoke. For instance, smoke escaping through slates or tiles on a roof may not be an indication that the roof is on fire, particularly in old property with a common roof void, because in such property the brickwork of the flue is sometimes faulty and smoke escapes from the chimney through the mortar joints into the roof cavity (see Fig. 24) and then through the slates, giving a false impression of a roof fire. In such a case confirmatory evidence must be sought before opening up. For example, the underside of the topmost ceiling will often indicate by touch and the presence of discoloration whether there is a fire in the roof void.

(c) *Other Indications.* Where smoke cannot be used to trace the fire there are several other indications which can be employed. Ordinarily the temperature increases as the outbreak is neared, though in the immediate vicinity of the fire it may be cooler on account of the inrush of air to feed the fire. Feeling woodwork, doors, etc., for heat is one of the most reliable guides, whilst blistering of paintwork and discoloration of plaster are reliable visual evidence.

When visible smoke is slight or absent, the sense of smell is valuable and will often prove a guide. If the smell of the smoke is not what might be expected from the supposed location of the fire, further investigation should usually be carried out before it is decided to open up. Thus, if coal smoke is smelt where wood smoke might be expected, a further search should be made for, say, a defective flue before, for example, opening up a roof void to which no means of access is provided.

If a sprinkler system is fitted, the noise of the water issuing from the operated heads will often give reliable evidence of the position of the fire.

The technique of "listening" may sometimes give results. If this is adopted as a last resort, two men only should enter the

building, and every endeavour should be made to prevent all extraneous noise. A search of the most probable location should then be made, with the ear kept close to the floor and near the skirting boards. Provided all movement is suspended when this is done it may be possible to hear the fire burning. Occasionally, in piles of packed merchandise, collapses in the pile will indicate the seat of the fire. Where all other means of tracing the seat of a fire have failed, it may be necessary, on rare occasions, to lay out hose lines to cover the suspected location of the fire and allow it to burn until it shows itself.

Whilst as a general principle a jet should never be put on smoke—even hot smoke—it may very occasionally be essential to use a diffuser branch to drive the smoke and thus enable the fireman to locate the seat of the fire. Water used under such circumstances, however, may do far more damage than the actual fire, particularly if it strikes such commodities as textiles on racks, machinery, etc.

It should not be overlooked that in warehouses and similar premises the stock is usually piled with narrow aisles between the stacks. Where the fire is in a different aisle from the branch, water may simply strike the stock pile and cause unnecessary water damage without doing any good. Such jets may even prove dangerous by knocking over insecurely stacked bales or boxes, or by wetting one side of the bale and so causing it to expand and tip over, or, alternatively, to burst, thus allowing the contents to run out and subsequently cause a collapse. Capsized stock piles make it very difficult to move about.

When searching for the fire, doors which are left open when the fire has not been located may cause extra draught and so result in spreading the fire. The fireman, therefore, should always close doors after him unless he intends to carry out ventilation operations. When it is desired to keep swing doors open, to avoid narrowing the available space, they should be so wedged that they open into the room and not on to a staircase or passageway.

3. DANGERS OF RAPID SPREAD

When the fire has been found, the next step is to prevent it from spreading by surrounding it at the earliest possible moment. Apart from the nature of the materials in the vicinity of a fire, the possible spread and intensity of fire in them will depend to a considerable extent on their arrangement. This is well illustrated by the fierce if small fire sometimes caused in private houses through a curtain blowing against a naked flame, such as a candle or gas jet. Material hanging in this way presents the maximum surface to the air, whereas the same amount of material rolled up would probably only smoulder. This is one of the reasons for the intensity of fires in shops and department stores where goods are arrayed on racks and display stands in such a way that air can circulate all round them, so that once ignited they burn with great rapidity.

The danger of rapid fire spread in well displayed goods should, therefore, be kept in mind when assessing the attendance required

METHODS AVAILABLE

Once the location and the nature of the materials on fire have been determined, a decision must be reached as to the means of extinction to be employed. This will depend mainly on :—

- (i) the size and intensity of the fire
- (ii) the nature of the materials involved.

The following are the various media employed for extinguishing fires, though they may not always be available to the Fire Service officer :—

1. Water from a soda acid or other similar extinguisher ;
2. Water from a hand pump ;
3. Water from hose reel equipment ;
4. Water from hose lines ;
5. Foam ;
6. Carbon tetrachloride (C.T.C.) ;
7. Carbon dioxide (CO_2) ;
8. Methyl bromide (CH_3Br) ;
9. Sand and powders ;
10. Steam.

A small fire which does not require the use of one of the above media may be :—

11. Blanketed ;
12. Beaten out ;
13. Removed.
14. Counterfiring and Demolition ;
15. Certain of the above media may be found as installed equipment.

1. WATER FROM CHEMICAL EXTINGUISHERS

These extinguishers have been dealt with in Chapter 9.

2. WATER FROM HAND PUMP

The construction and use of hand pumps has been dealt with in Chapter 8.

3. WATER FROM HOSE REEL EQUIPMENT

Of all Fire Service equipment, that which is used in the largest number of cases for dealing with small outbreaks is the hose reel equipment fitted to many appliances (see Part 2, p. 33). The advantages which it possesses are considerable, the more important being :—

- (i) It is ready to get to work immediately the appliance draws up at the scene of the fire.
- (ii) The jet can be controlled at the nozzle, and water damage can be kept to a minimum.
- (iii) The tubing is coiled on a revolving reel from which only as much as is required need be run out.

(iv) The charged tubing is considerably lighter and easier to manhandle than full size delivery hose.

The disadvantages are :—

(i) The length of hose being limited, the radius of operation from the appliance is restricted. Some hose reel equipment is fitted with couplings so that additional lengths can be added to extend the range. Alternatively, the tubing can be connected to delivery hose by means of a hose reel adaptor.

(ii) The capacity of the hose reel tank, which on most appliances ranges from 45 to 60 gals., is limited, and arrangements will always have to be made to replenish the tank in case the quantity carried proves insufficient. In built-up areas where hydrants are numerous, there will normally be little difficulty in doing this before the tank is empty, but elsewhere it may be more difficult to arrange. Hose reel tanks carried on some appliances, *e.g.*, the escape-carrying unit, are of considerably larger capacity and the quantity of water which they contain is usually sufficient to extinguish any fire which can be dealt with by the size of jet given by the hose reel nozzle.

The use of water from mobile dam units, which are in some respects analogous to appliances fitted with hose reel tanks, is dealt with in the Chapter on "Fires in Rural Areas."

4. WATER FROM HOSE LINES

When water in the quantities provided by the three methods mentioned above is insufficient to extinguish the outbreak, the use of one or more hose lines becomes necessary.

(a) *General Considerations.* Two main sizes of hose have been issued to the National Fire Service to supply firefighting branches, 2½-in. and 2¼-in. dia. The great bulk of the former is rubber-lined and the latter usually (but *not always*) unlined. A certain amount of 1½-in. dia. unlined canvas, in addition to duck-covered rubber, hose is also in use. The construction of these types has been dealt with in Chapter 4, and the influence of size and type on their hydraulic performance described in Chapter 19. Larger hose such as 3½-in. is only used for (a) water relaying : (b) on fireboats ; and (c) for feeding fixed jets such as radial branches or deluge sets. Its weight when charged would make it extremely difficult to manhandle if it were used in conjunction with branches which were continually being moved. The 1½-in. hose is occasionally employed with a small diameter nozzle or diffuser branch in rural districts where water is scarce, and the duck-covered hose sometimes in cases where no hose reel equipment is carried on an appliance.

The correct method of running out hose has already been described (Part 1, p. 43), so that only those factors which influence its use from the practical firefighting point of view will be considered here.

(b) *Type of Hose.* Rubber-lined hose should always be employed in preference to unlined hose for those lengths which pass into, or through, a building, because the absence of percolation will prevent

water damage which might otherwise occur. On the other hand, unlined hose is to be preferred for hose lines which must be laid out over hot materials, since the wetting of the jacket by percolation will prevent scorching, which might occur with rubber-lined hose, the jacket of which will be dry and hence vulnerable to heat.

(c) *Size of Nozzle.* The general aim of the fireman is to bring the fire under control in the minimum time, whilst causing as little water damage as possible, so that when the fire requires the use of hose lines the most important point to decide is the type of branch and size of nozzle to be employed. At a relatively small fire the first branch to be got to work should usually be of the shut-off type, which will render it easier to control the application of water and avoid water damage and will make manœuvring very much easier. Additional branches will generally have plain nozzles, since these give better jets and can be of larger diameter than $\frac{3}{4}$ -in., the maximum size which can be used efficiently with a hand-controlled branch.

It should be remembered that branches having nozzles of $\frac{1}{2}$, $\frac{3}{8}$ or $\frac{3}{4}$ -in. dia. are more easily handled than those of larger size (1-in. or $1\frac{1}{8}$ -in.), and that in certain types of fire, such as in hotel or office corridors when a number of rooms must be entered, a considerable amount of movement of the branch will be necessary. It may, therefore, be preferable to use two or three small nozzles rather than one large one. Once, however, considerable quantities of stock are burning it will be essential to use large nozzles, because only they will :—

- (i) deliver the volume of water required ;
- (ii) give the throw necessary to strike the materials which are actually burning ; and
- (iii) reach the fire without the jet breaking up or turning into steam (see Part 3, p. 19).

(d) *Laying out Hose lines.* When getting a line of hose to work, sufficient excess length must be provided (laid out where circumstances permit in a long bight near the branch), so that the branch can be advanced as desired without it becoming necessary to shut down the hose line to add further lengths (Fig. 2). If the hose line is not long enough, the delivery must be shut down whilst a new length is added, and whilst this is being done the fire may get away.

The first line of hose to be got to work is usually taken up the staircase. To work charged hose up a staircase which is on fire or heavily charged with hot smoke and gases is an exhausting process, and may in high buildings require as many as four men. In such

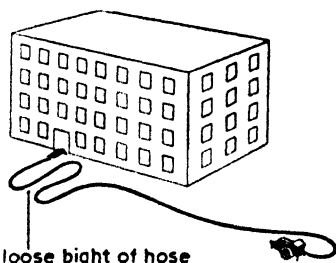


Fig. 2. Showing method of laying out hose so as to provide an adequate bight in order that the branch can be advanced into the building without having to be shut down to add an extra length.

a case two should be on the branch and two behind supporting them and backing them up. If insufficient men are available, then it will be necessary to ask for the pressure to be reduced while the branch is moved and increased again when the branch is in its new position.

It will often be found that better progress can be made with a shut-off branch, since the flow can then be reduced or cut off entirely when it is necessary to advance and opened up again when the new position is reached. When a hose line is being worked up a staircase, the jet should not be allowed to strike the walls at too close a range, otherwise burning materials and hot plaster will be thrown into the faces of the branchmen.

When hose is laid out on a staircase, every effort should be made to avoid kinks, which restrict the flow severely and may lead to bursts. When it is being worked up the staircase it will normally have to be laid up the treads, but if this is not necessary, then it is preferable to suspend it vertically up the well, taking care that it is adequately supported in the same manner as when hoisted up the outside of a building.

With the exception of the first line of hose to be got to work, hose lines should for the following reasons whenever possible be taken up outside a building and should enter at the most convenient floor from which to reach the fire :—

- (i) The hose lines are much shorter, and there will be less frictional resistance.
- (ii) Staircases and passageways are kept free.
- (iii) There is no risk of percolation from unlined hose or leakage from couplings causing water damage in the premises.
- (iv) The hose can be more easily hoisted into position and time saved.
- (v) The hose lines are easier to trace.

The hose can either be hoisted up by a line or carried up a ladder or escape.

(i) *Line Lowered from Above* To take hose up the outside of a building by means of a line, it is necessary for a fireman carrying a line to gain access to the appropriate part of the building and then to lower one end to those below. The end is then made fast to the uncharged hose about 8 to 10 ft. from the branch by means of a rolling hitch (see Chapter 39, Fig. 6). The tension of the rolling hitch must be so adjusted that when the hose is charged the flow will not be restricted. A clove hitch is then made on the branch in the manner described on p. 223, the length of line between the two hitches being so adjusted as to leave a bight of hose between them. The fireman in the building then hauls up the hose whilst the man below guides it up, endeavouring to prevent the branch striking any projections.

When the hose has been hauled up to the point where it is to be taken into the building, the clove hitch is removed from the branch and the line is then made fast to some suitable object which will sustain the weight of the charged hose, but before the line is secured

care must be taken to see that the rolling hitch lies about 2 ft. below the coping or window sill over which the hose runs into the building. To prevent chafing, suitable material such as sacking, a doormat, etc., should be placed between the hose and the point of contact with the building.

To add a length of hose to a charged line suspended in this way, the coupling at ground level should be broken and the vertical lengths allowed to drain. A further length or lengths of hose are then connected at the break and the hose line hoisted up the building, re-secured by the line and again charged. With this method, only the amount of additional hose which is actually required need be drawn into the building. Alternatively, if it is impossible to break the coupling at ground level, the additional length of hose may be added at the branch.

(ii) *Up a Ladder.* To take hose up a ladder or escape the branch should be connected and the hose led up under the right armpit and brought up over the right shoulder, with the branch hanging down the back (Fig. 3 (i)). Alternatively, the hose may be brought up under the right arm, passed across the chest and over the left shoulder with the branch down the back (Fig. 3 (ii)). The advantage of the first method is that if the hose line should be charged by mistake whilst the man is still on the ladder, it is easy to cast it off. The disadvantage is that the hose does not grip very well and tends to slip off the fireman's shoulder when he is climbing. With the second method there is a possibility of being thrown off the ladder if the hose is inadvertently charged, but the purchase on the hose is much firmer.

Hose reel nozzles are often fitted with a loop (Fig. 3 (iii)), which

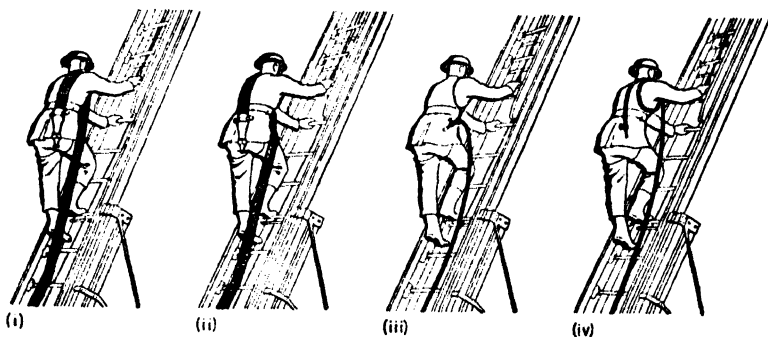


Fig. 3. Four methods of taking a line of hose up an escape or ladder : (i) hose led up under the right armpit and branch hanging down over the right shoulder ; (ii) hose led up under the right armpit, across the chest and over the left shoulder ; (iii) hose reel tubing with a loop of line slipped over the right shoulder ; (iv) hose reel tubing coiled round the right shoulder.

can be slipped over the shoulder and takes the weight of the tubing, leaving both hands free. If no loop is provided, the tubing may be looped round the shoulder to give adequate purchase (Fig. 3 (iv)).

The man then climbs the ladder, the hose or tubing being eased up by one or more members of the crew.

The weight of charged hose lying on a ladder must always be taken by some means of support (Fig. 4), such as a hose sling, hose becket and belt line, or, if these are not available, by making it fast

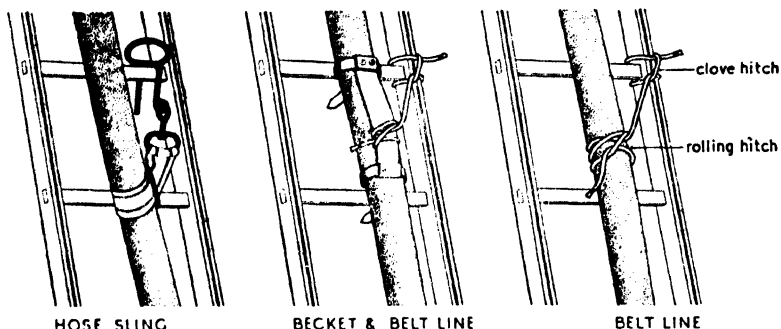


Fig. 4. Various methods of supporting the weight of charged hose lying on a ladder.

with a belt line only using a rolling hitch. A branch and hose taken up a ladder may in the first place be got to work from the ladder, but at the earliest practicable moment it should be taken into the window or over the parapet, etc., against which the ladder is pitched. The hose should be led over the head of the ladder into the building and, in the case of an escape, laid over the levers so as to prevent it kinking or fouling the guy wires. If, however, a line of hose which has been taken into a building up an escape is likely to be required for some time, then consideration should be given to removing it from the escape and suspending it by a line, so that, if circumstances permit, the escape can be made up and returned to its station.

(e) *Use of Branches.* One of the first essentials in efficient fire extinction is correct branch holding, which will do much to reduce fatigue and prevent accidents. The following are some of the more important points to which attention should be paid :—

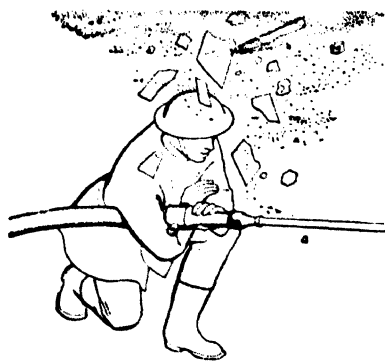


Fig. 5. Holding the branch so that the hands are protected from debris falling from above.

(i) *On First Entry.* When working a branch into a room which is well alight, the branchman should crouch in the shelter of a doorway or other suitable opening and first direct the jet overhead and slightly in front of him, to dislodge anything which may be hanging insecurely; and this action should be repeated periodically as he advances.

He should not look up while doing this, and should hold the branch so that his hands are kept as close in to the body as possible, to protect them from falling débris (Fig. 5). This is of particular importance in the case of top floors, where the roof may consist largely of glass which may be cracked by the heat and therefore liable to fall at any minute.

(ii) *On the Ground.*

When holding a branch (Fig. 6), the man on the left of the hose (when facing forward towards the nozzle, *i.e.*, the man on the right in the figure) should allow the hose to come up under his right arm, his right hand being on the coupling underneath but not grasping the lug; his left hand on the nozzle, back of the hand uppermost.

Many experienced branchmen prefer to support the right hand on the left arm, thus tucking the hose into the crook of the right elbow (Fig. 7). The man standing on the right of the hose will generally best be employed supporting the hose and exerting a forward pressure to counteract the jet reaction. The hose should be laid out behind the branchmen in as nearly a straight line as practicable, as this will serve to absorb some of the jet reaction. If a third man is on the branch he should stand on the left behind the more forward man and help to support the hose.

Except when one of

the smaller jets is in use, two men should always be on the branch before the full pressure is allowed to develop. When for any reason this is impracticable, the branchman may find it of assistance to

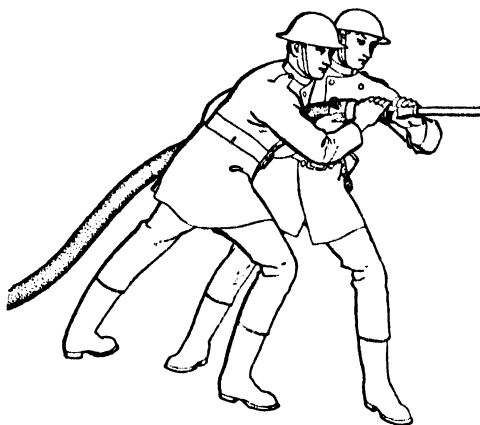


Fig. 6. Standard method of holding a branch (two men).

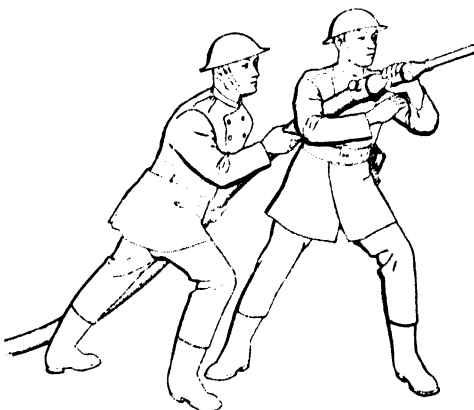


Fig. 7. Alternative method of holding a branch so that the weight of the charged hose is supported on the right forearm.

position himself against a wall, preferably in a corner, in order that he may obtain the maximum of support to resist the jet reaction.

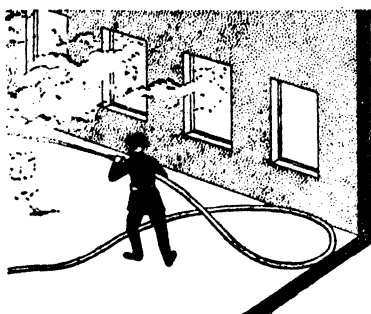


Fig. 8. Diagram showing how a corner may be used to take part of the reaction of the branch by supporting the hose line.

Alternatively, it may be possible for him to place the hose (Fig. 8) so that the walls of a corner take part of the reaction.

Once control of a branch is lost it is difficult to regain. If the branchman feels that he is losing control he should throw himself on top of the branch, holding on to it tightly and pinning it between him and the floor until assistance arrives. A branch out of control can cause serious injury to anyone it strikes, and accidents of this kind are by no means rare. It

should be emphasised that it is the urgent duty of any officer or man, irrespective of rank, to throw himself on the hose as close to the branch as the movement of the hose permits, and crawl along it, thus progressively shortening the free hose and reducing the kicking effect.

Whilst correct branch holding is of particular importance when a fireman is working in difficult positions, such as on a roof, ladder, etc., the pump operator who has a delivery at work under such conditions must also be continually on the alert, so that he can reduce the pressure should there be any indication that the branchman is losing control.

(iii) *On a Ladder.* Operating a branch from a ladder is usually only a preliminary to entering the room, and arrangements must always be made to have a sufficient bight of hose available which can be worked forward as soon as entry is made. The hose line should be led up the ladder and secured by means of a line or by a hose bucket in order to relieve the branchman of the weight or, if this is impossible because the branchman is advancing, one or more men should assist in lightening the hose up the ladder.

There are several methods of holding a branch on a ladder, the more suitable of which are illustrated in Fig. 9. In the first method (Fig. 9 (i)), the hose is led up over the right shoulder, the branch being held in position with both hands. This method, whilst not suitable for continuous working, has the advantage that when the fireman is first attacking a fire in the room to which the ladder is pitched, the face can be kept almost at sill level, and is thus protected from the heat and smoke escaping from the window.

In the second method (Fig. 9 (ii)), which can be used when the head of the ladder is pitched to but not above the sill, the branch is held very much as when on the ground, whilst the third method (Fig. 9 (iii)) can most suitably be employed when the ladder projects several rounds above the sill. If it is necessary to work

from an intermediate position on a ladder, the branch should be held close to the string, one arm being passed through the ladder to

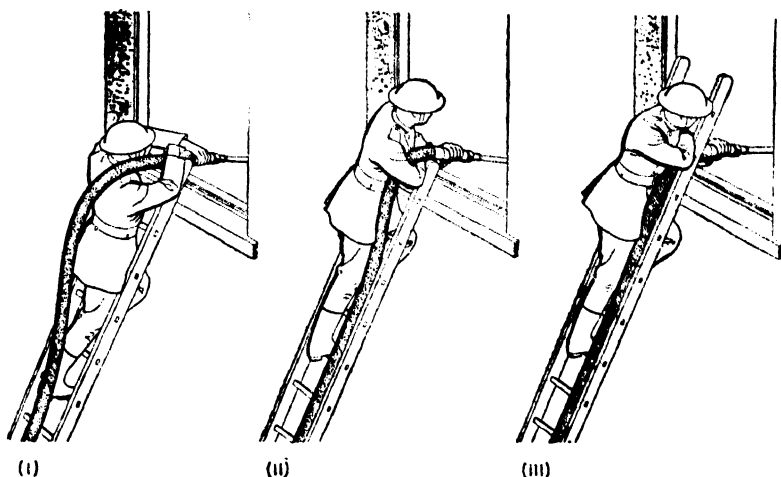


Fig. 9. Three methods of holding a branch at the head of a ladder preparatory to entering a room on fire.

grasp the branch, whilst the other supports the base of the branch or forward end of the hose line.

A man operating a branch from a ladder or an escape should always take a leg-lock (see Part 1, p. 115); if working to the left, the lock being taken with the right leg, and if to the right, with the left leg. The heel of a ladder from which a branch is to be got to work should always be drawn somewhat further out from the building than when in normal use, and whenever conditions permit, the head of the ladder should be secured with a line. There must at all times be a man at the foot of the ladder whilst a man is on it. Whilst it is essential to hit the fire with the jet, it is well to remember that if the branch is directed far to one side the stability of the ladder may be affected by the sideways thrust, which may cause it to capsize.

(iv) *Use of Jets.* When fighting a fire with water, every attempt should be made to strike the burning material with the jet, the principal requirement being to cool the material actually burning to a temperature below its ignition point. Surrounding materials which may become involved should be damped down with a quick splash round and the jet immediately re-directed at the heart of the fire; water which strikes mere flame or smoke does little good. It must be emphasised that it is virtually useless to keep a jet directed at one spot only; it should be kept in constant movement so that the maximum area of burning material is cooled, the aim being to cool and extinguish a small section which is then progressively enlarged. Where a vertical surface is involved a start should be made low down, in order to reduce the effect of the rising

flames and hot gases which, if this is not done, will only serve continually to re-ignite material above.

When, on account of obstructions, it is impossible to strike the fire directly with a jet, it may be possible to use a ceiling or a wall

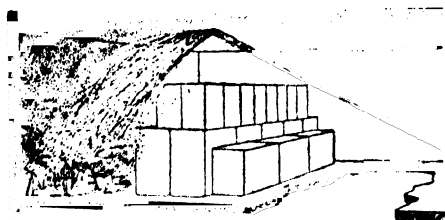


Fig. 10. Sketch showing how a ceiling can be used to direct water on to a fire which is unapproachable because of a collapsed floor.

to deflect the water on to the burning materials. The angle at which the jet will be directed, will depend on the relative positions of branch, obstruction and fire (Fig. 10). When the building cannot be entered and it is necessary to direct a jet into a window from a ladder or from street level, the influence of angles should be kept in

mind. This is clearly indicated in Fig. 11 (*left*). To obtain the maximum penetration it is, of course, obvious that the branch should be placed as far away from the building as the reach of the jet permits, in order to obtain a lower trajectory.

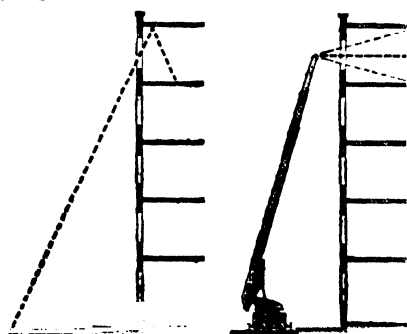


Fig. 11. Diagrams showing the influence of angles on the reach of a fire stream. Left: jet directed into a window from street level which fails to penetrate into the building. Right: jet from a turntable ladder level with a window showing effective reach into the building.

One of the principal virtues of the turntable ladder monitor is that when operated on a level with a window or other opening (Fig. 11, *right*) it can project a jet almost horizontally and thus strike a fire deep in the building which could not otherwise be reached by jets from outside. This advantage is of particular value at a fire on a top floor when the roof has collapsed or when access from inside is particularly difficult. The man at the head of the ladder should satisfy himself that his elevation and angle

enable him to strike the fire with maximum effect, and should ask the turntable ladder operator to make the necessary adjustments which the changing fire situation demands.

(v) *Use of Spray.* Certain types of fire requiring the use of water must not be attacked with a jet. These include all fires involving inflammable liquids, which the jet would tend to break up and disperse more widely, and such fragile commodities as glass carboys. For these a spray should be used. Fire involving inflammable powders and dusts, such as flowers of sulphur, starch and flour, should also

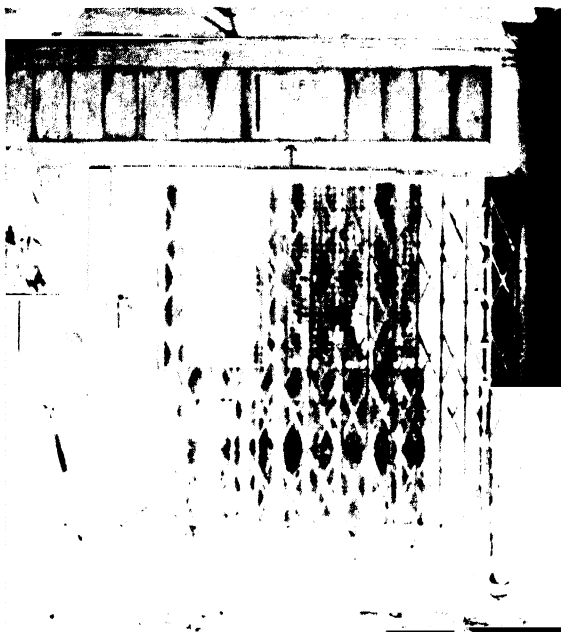


Plate 1. Lift gates in the basement of a building. A fire started in this basement and spread up the shaft to the top floor leaving the intervening floors (see Plates 2 and 3) virtually unaffected.

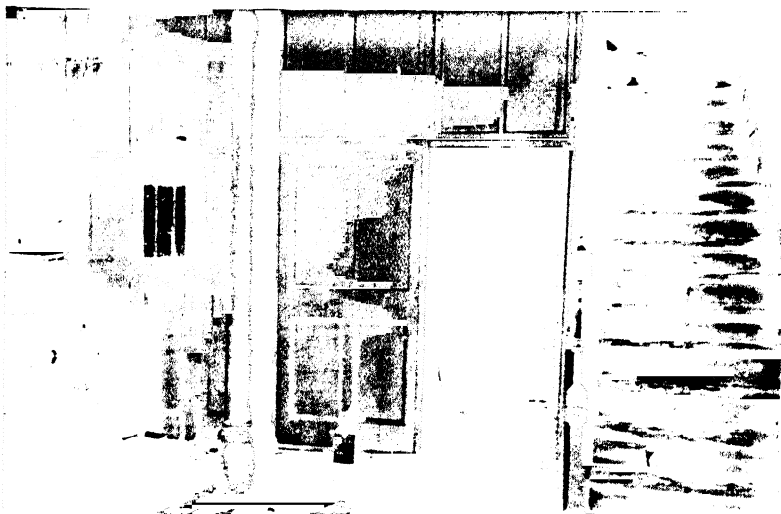


Plate 2. The ground floor of the premises shown in Plate 1 above, showing how, except for the breaking of a few glass panels, the fire travelling up the lift shaft, which is located on the left, has not affected this floor.



Plate 3. The first floor of the building illustrated in Plates 1 and 2. The shaft has been enclosed on this floor and the disused gates can be seen behind the book shelves on the left. Note the greater intensity of charring of the woodwork surrounding the shaft.

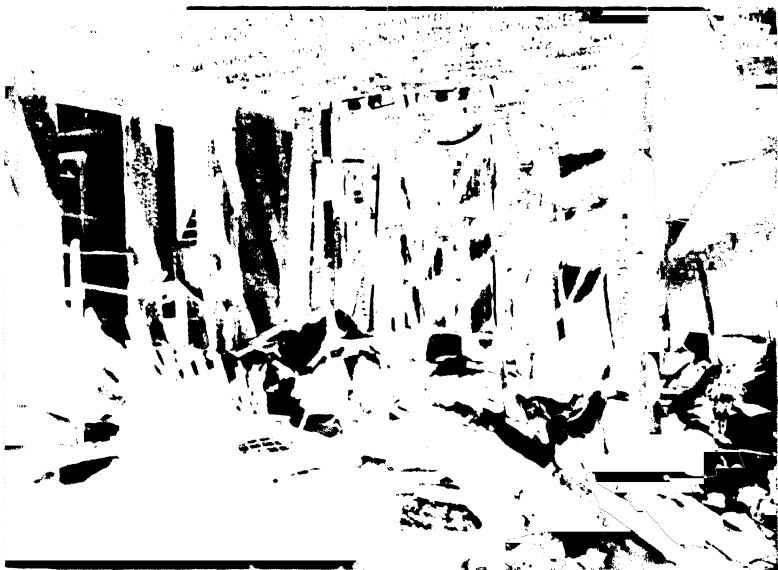


Plate 4. The top of the lift shaft and top floor of the building illustrated in Plates 1, 2 and 3. Note how the fire has "jumped" the intermediate floors and caused the total loss of the top floor in which the heat and smoke mushroomed out before it found a vent.



Plate 5. Exterior view of the building illustrated in Plates 1 to 4. Several rescues are being carried out using escapes. Note how the smoke is emerging from the top floor, although at the time the photograph was taken much of the fire was in the basement.



Plate 6. Photograph showing an opening cut in a fire wall after the construction of the building in order to carry a pipe from one side of the wall to the other. The fire which occurred on the far side was prevented from spreading by the fire-resisting doors shown in the lower left-hand corner, but a certain amount of heat passed through the pipe opening and would, if it had not been detected, have led to an outbreak in this compartment. This photograph emphasises the importance of maintaining a patrol on the far side of a fire or party wall.



Plate 7. This photograph shows an otherwise imperforate party wall with an opening which had been made at some time after the construction of the building to accommodate shafting. Fire passed through the opening from the compartment on the far side and caused a small outbreak on the side from which the photograph was taken. It was, however, discovered in its early stages and extinguished with relatively little damage.

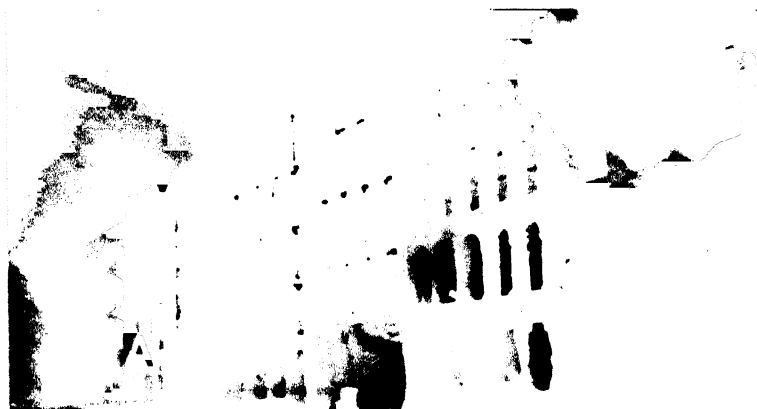


Plate 8. Photograph showing the way in which flames can curl from one window into another and thus spread fire. This is very clearly shown at "A." Note also the way in which flame continues to linger on the upper parts of window openings.

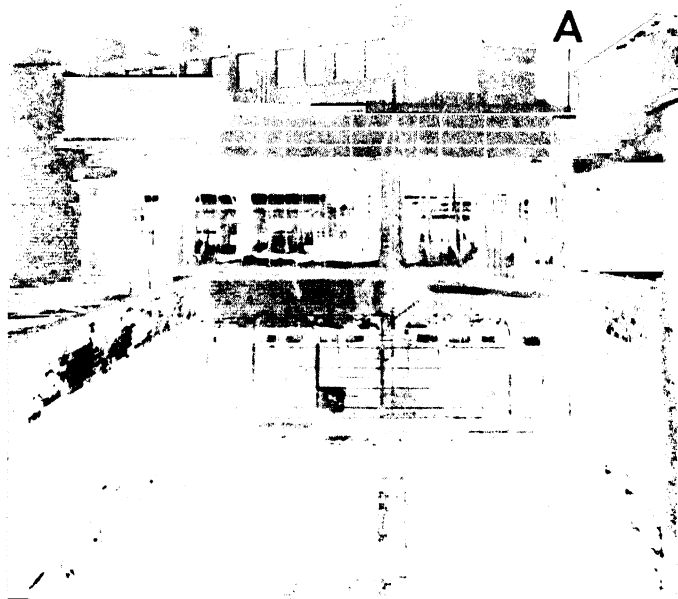


Plate 9. The light well of a large industrial building which was divided into compartments by fire-resisting walls. The fire originated in the block on the right-hand side but was able to outflank the fire wall, the top of which can be seen at "A." through the windows on to the light well, thus involving the whole structure.



Plate 10. Showing how steel stanchions, which have been encased in brick, have been protected from the heat of a severe fire and consequently from distortion.



Plate 11. Photograph showing a fire-resisting door on a fusible link obstructed by packing cases placed against it. The link operated and the cable can be seen hanging down. As the door was unable to move, fire spread from one compartment to another and was only detected when a patrol was detailed to work through the building and verify that all fire-resisting doors had been closed.

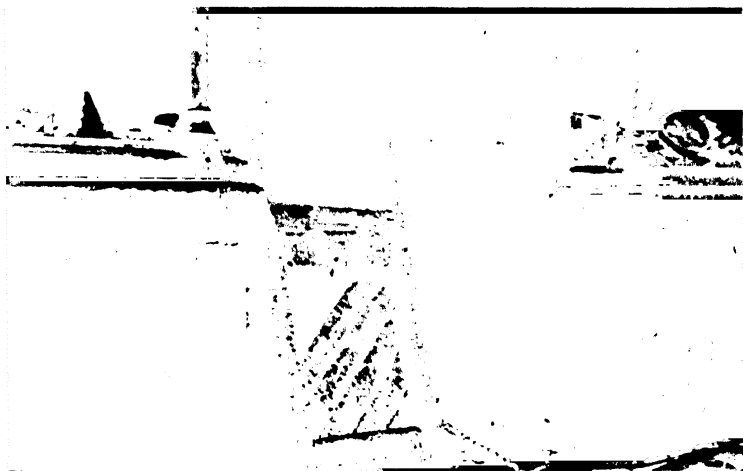


Plate 12. Charring caused by the effect of radiation from a fire on the opposite side of a street which was, however, only some 20 ft. wide.

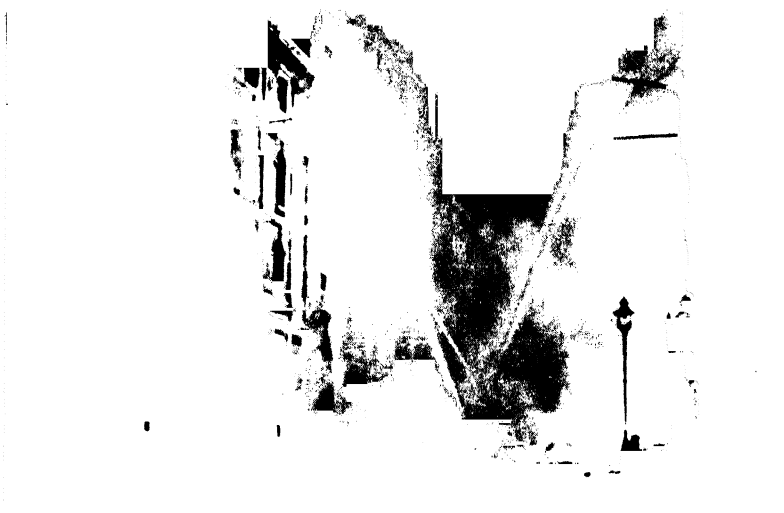


Plate 13. Photograph showing the effect of radiant heat. Note how the water from jets used to cool the face of the building opposite that on fire is being turned to steam.



Plate 14. This photograph shows how fire can spread in a concealed space - in this case between the plaster of the ceiling and the tiled roof of a dormer window. Note the charring of the woodwork in the void, indicating a fire of sufficient intensity to burn through the roof, yet the curtains at the window are undamaged and the paintwork on the frame scarcely blistered. The plaster was intact until pulled down to facilitate fighting the fire.

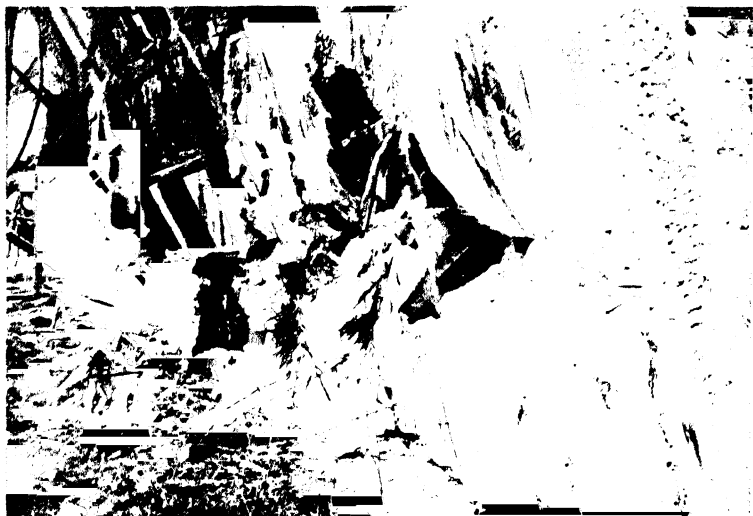


Plate 15. Close-up view of the sound insulation in a stage used for making sound films showing construction very similar to that employed for cold stores. Unless non-inflammable insulation is employed, fire can spread very rapidly and involve the whole structure.

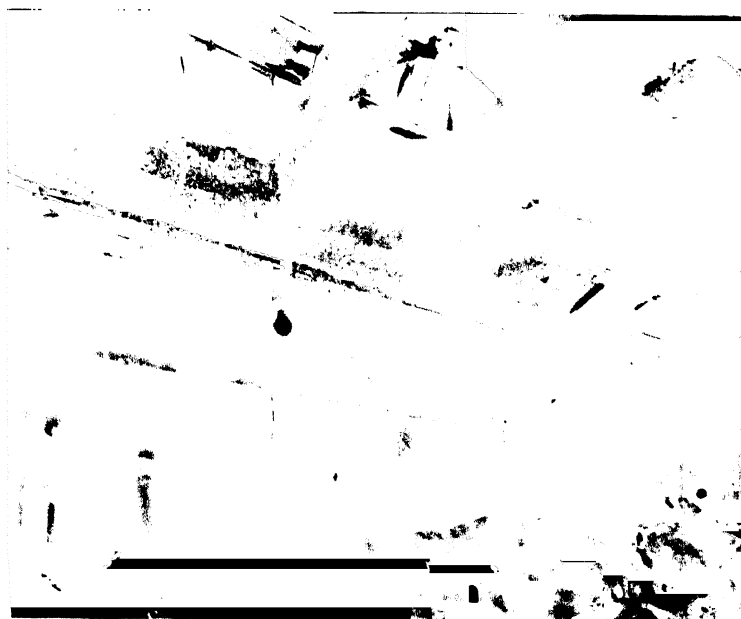


Plate 16. Photograph showing the construction of a cold store insulated with granulated cork. Fire involved part of the insulation and the boarding holding it in place has been stripped away. Note that to get at the boarding it has been necessary to remove a section of the brine pipe. The iron strap holding it in position can be seen doubled down and hanging vertically.

be attacked by means of a spray, since a jet will raise clouds of the dust and may lead to a series of minor, and possibly a major, dust explosion. The correct extinguishing medium to use for the commoner types of substance will be found in the Chapter on "Special and Unusual Risks."

When it is necessary to cool a large area, such as a steel bulkhead, to prevent fire spread, a spray should always be used, provided that the throw is such as to reach the target, because less water is required, far better distribution is obtained, the finely divided state of the water permits it to vaporise more readily and thus absorb more heat, and there is less risk of causing distortion and consequential damage.

(f) *Use of Dividing Breechings.* Dividing breechings (see Part 1, p. 72) are used to divide a single line of hose or a single outlet to give two lines of hose. They are of two main types:—

simple dividing breechings;

control dividing breechings, in which the flow in either or both legs may be shut off by one or more valves.

The amount of water which a line of hose will pass depends, amongst other factors, on:—

- (i) the pressure at the pump;
- (ii) the diameter and type of the hose;
- (iii) the length of the hose line;
- (iv) the size of the nozzle in use.

Factor (i) is limited by the type of pump and by the safe working pressure of the hose, whilst (ii) is limited, for hose run out by hand, to $1\frac{1}{2}$ -in., $2\frac{1}{4}$ -in. and $2\frac{3}{4}$ -in. dia. hose, lined or unlined. Factors (iii) and (iv) are dictated entirely by the location and nature of the fire, and (iv) also by the quantity of water available.

It can immediately be seen that to run out a long line of hose and divide it into two lines by means of a breeching is to create hydraulic conditions which will render it impossible to get two efficient jets of any substantial size. Such a lay-out is, therefore, only justified where:—

(A) Small diameter jets only are required, for example, in fighting most rural fires and for cooling down and turning over. In this case it is preferable to run out a single line of $2\frac{1}{2}$ -in. or $2\frac{3}{4}$ -in. hose and divide into two $1\frac{1}{2}$ -in. lines, if this size hose is available, as this requires less water to charge the hose, and the smaller diameter hose makes for ease of handling, particularly where the position of the branch must be frequently altered. For turning over, for instance, it may be possible, by subdividing hose lines in this way, to supply up to four $\frac{5}{8}$ -in. or $\frac{3}{4}$ -in. nozzles.

(B) The length of the hose lines required is such that the available hose is insufficient to provide two complete lines. In such a case, a decision must be made as to whether one line of hose with one good jet or a divided line with two smaller jets will be the more suitable. In this case, if two shut-off branches are available, a divided line may prove of considerable value, for by closing one, pressure can be increased in the other to deal with a temporary difficulty.

Except in such unusual cases, or where only a pump with a single

delivery is available, the use of dividing breechings in hose lines should be avoided for the following reasons :—

(i) A single line of hose is, in most cases, incapable of conveying the quantity of water required to supply two efficient firefighting jets, unless they are of relatively small dimensions.

(ii) Unless a control dividing breeching is available, shutting down one jet involves shutting down the other.

(iii) Damage to the single hose line will shut down two jets instead of one only, as when individual hose lines are employed.

(iv) Unless a control dividing breeching is available, the order for "water on" must be delayed until both lines of hose are completed and both branches are in position.

A plain breeching connected to the delivery of a pump will be open to the same objections, with the exception of (i) above, but a control dividing breeching will, of course, have the same effect as adding an extra delivery except for the loss of hydraulic efficiency.

The general rule, therefore, should be that a separate line of hose should normally be run out for each branch which is to be got to work, particularly in the initial stages of the operations, when rapid changes in the fire situation may render it necessary to move individual branches without shutting off others. Even if it is essential to use small jets, either because of shortage of water, the nature of the fire or inadequate manpower, individual hose lines should be employed because of the greater control obtainable.

It should be emphasised that whenever a dividing breeching is inserted in a hose line, the size of nozzle in use must immediately be reduced, in order to provide an effective jet. It is useless to divide a line of hose supplying a 1-in. nozzle and put a 1-in. nozzle on the second line also.

(g) *Maintaining a Useful Jet.* No branchman should be content with an indifferent jet and, if it appears inadequate, he should take such steps as he can to remedy the position, for example, by sending a man back to check the hose line for leaks or a burst and see whether it has been constricted by debris falling on it or by a vehicle parked on it. If it appears to an officer that a jet is not doing useful work, he should not hesitate to change its position, substitute a smaller nozzle or, if necessary, to shut down.

(h) *Burst or Damaged Hose.* When a length of hose bursts or is otherwise damaged on the fireground an overhand knot should be tied at one end to identify it as unserviceable. Damaged couplings should be identified by a piece of string tied round the coupling or lug.

5. FOAM

All types of hand foam extinguisher (Part 1, p. 148) must be inverted to actuate them. To accelerate the diffusion of the two liquids, it will often prove helpful to give the extinguisher a rapid shake, at the same time holding the finger over the nozzle to allow the pressure to build up before release.

When a foam extinguisher is in use, foam should not strike the surface of the burning liquid, but should be directed against a side wall or any vertical surface of the container (Figs. 12 and 13), so that

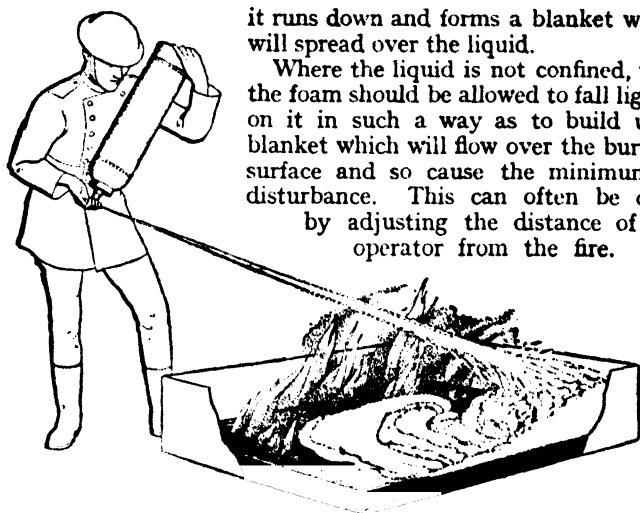


Fig. 12. Correct method of directing the discharge from a foam extinguisher so that the foam builds up a blanket which flows over the burning liquid.

use of foam on a large scale for extinguishing fires in oil tanks is dealt with in the Chapter on "Fires in Oil Installations" and in fixed installations in the Chapter on "Fixed Firefighting Installations, Part II."

6. CARBON TETRACHLORIDE

A C.T.C. extinguisher (see Part 1, p. 152) should be used where appropriate on electrical fires and small petrol fires, particularly those in motor cars, etc., and is also valuable for extinguishing fires in letter boxes, since the confined space assists the blanketing action and the C.T.C. will not injure the unburnt letters. When C.T.C. has been used on a letter box fire in this way the slot and any other

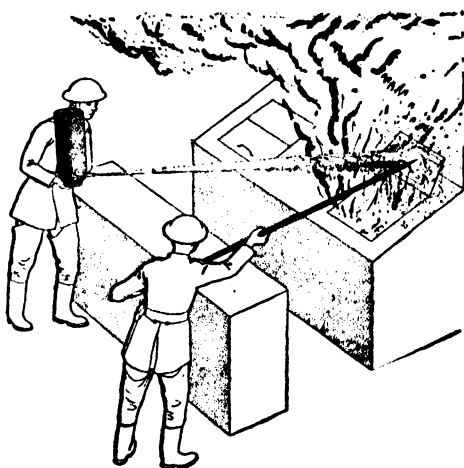


Fig. 13. Tackling a fire in a fish frying pan with a foam extinguisher. The man with the ceiling hook is getting ready to pull down the cover when the foam has been applied. The construction of the pan can be clearly seen in Plate 22 facing p. 44.

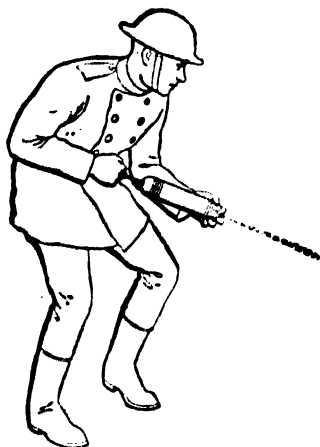


Fig. 14. Method of operating a C.T.C. extinguisher. The fore-finger can readily be placed in front of the nozzle to diffuse the jet should this be necessary.

openings should be sealed up to keep the concentration as high as possible.

The jet from a C.T.C. extinguisher (Fig. 14) may go through a small fire without giving the blanketing effect desired; if so, it may be possible to get a better effect by diffusing the jet by placing a finger on the nozzle. Whilst the stream of liquid C.T.C. is a non-conductor, care must be taken to see that the metal of the extinguisher is not allowed to come into contact with any live electrical apparatus. The vapour of C.T.C. is very toxic and care must be taken thoroughly to ventilate any compartment in which it has been used.

7. CARBON DIOXIDE

CO₂ extinguishers (see Part 1, p. 159) are carried in some localities on Fire Service appliances, and will occasionally be found as part of the firefighting equipment in commercial or industrial premises and electric generating stations (see the Chapter on "Fixed Firefighting Installations, Part II"). They are sometimes installed in fish frying establishments, since the CO₂ does not contaminate the frying oil when discharged on to it. The same precautions should be taken in handling them as with any other compressed gas cylinder.

The discharge should be directed at the heart of the fire, starting at one edge and sweeping slowly across the surface of the burning

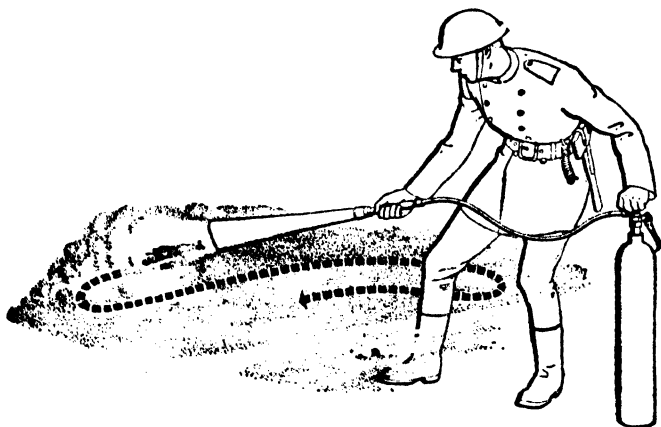


Fig. 15. Method of operating a CO₂ extinguisher by sweeping the discharge horn slowly across the surface of the burning material.

material (Fig. 15). If it is necessary to use a CO_2 extinguisher in the open air, the operator should stand up-wind of the fire and apply the gas in a down-wind direction, as close as possible to the fire. It should not be overlooked that the time of discharge of a CO_2 extinguisher is limited (usually to one minute) and that the maximum possible use must be made of this time if it is to be effective. If the fire is not completely extinguished, then, unless another extinguisher is immediately at hand, little useful work will have been accomplished, since the fire will flash back. It should also be remembered that re-ignition is always liable to occur unless all the burning material has been cooled below its ignition temperature. Carbon dioxide in heavy concentrations renders the atmosphere unbreathable, and after a CO_2 extinguisher has been used indoors and the fire extinguished adequate steps should be taken to ventilate the room. Owing to the intense cold generated on discharge of the gas it should not be directed on to exposed flesh.

Other points which may be mentioned in connection with CO_2 extinguishers are :—

(i) The gas makes a considerable noise during the short period of its discharge, and, if the fireman has not used such an extinguisher before, the unexpected sound may take him off his guard and cause him to misdirect the jet for the first vital seconds.

(ii) The CO_2 issues from the extinguisher in the form of a very dense vapour which, in a confined space, will impair visibility considerably.

(iii) It cannot be too strongly emphasised that, owing to the fact that CO_2 extinguishes a fire without any substantial cooling effect on the burning materials, a CO_2 extinguisher must always be backed up either with additional CO_2 extinguishers or water. This is particularly so when it is being used on a fire such as that in a chip-pan, since, if insufficient CO_2 is available, a flashback from the heated flue is almost inevitable and no good will have been done by its use.

(iv) If for any reason the orifice at the sealing disc should freeze, thus preventing the discharge of the gas, the control valve should be returned to the position in which it was before operation and the extinguisher again operated ; in some models this will clear the stoppage.

8. METHYL BROMIDE

Methyl bromide (see Part 1, p. 157) is stored as a liquid which vaporises rapidly on discharge. The stream should, of course, be directed on to the burning materials (Fig. 16), except in the case of liquids, when it may tend to dissolve in the liquid without producing the maximum extinguishing effect. In this case it is better to diffuse the jet by directing it at the side of the container or some other object, which will prevent the methyl bromide stream driving into the burning liquid, and yet allow the gas to diffuse so as to give the maximum effect.

The toxicity of the vapour can be severe, and the compartment in which it has been used should be thoroughly ventilated. It

is an interesting medical fact that susceptibility to poisoning through the inhalation of C.T.C. or methyl bromide vapour varies greatly with different individuals. Concentrations which would leave one person virtually unaffected (with possibly the exception of a bad headache) may result in the death of another.

The installation of CO₂ or methyl bromide extinguishers in a building will often (but not always) indicate the presence of some unusual risk.

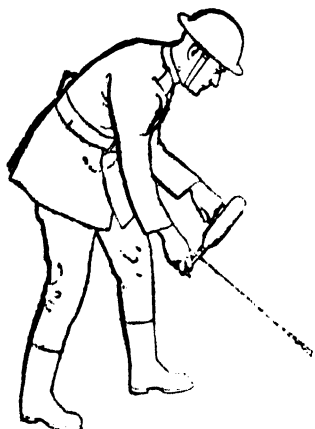


Fig. 16. Operating a methyl bromide extinguisher.

9. SAND AND POWDERS

Some burning materials which cannot be extinguished by the use of water may be dealt with by means of dry earth or sand which excludes the air. Dry sand may also be used for dealing with fires in letter boxes and for preventing burning liquids such as oils and paints from flowing down drains, basement lights, etc., and for confining shallow layers of such liquids, thus permitting the use of foam or spray branches. On no account should sand be employed for extinguishing fires in machinery such as electric motors, since its use may well necessitate the dismantling of the entire machine for cleaning, even though the fire damage is negligible. Sand should be applied with a spade or by hand, working progressively across the burning material. A sweeping action such as is used to grit a road may prove effective.

In some premises, stocks of special powder will be found for dealing with fires in commodities such as magnesium for which other media are unsuitable. If these powders are readily available they should, of course, be used, but it will be found in general that they are only suitable for relatively small fires. The whole of the burning mass should be covered with the powder in order to exclude oxygen. Dry powder extinguishers are dealt with in Part 1, p. 161.

10. STEAM

In certain types of premises and also in ship fires (see Part 7, p. 116) steam may also be used as an extinguishing agent, if it is available in sufficient quantities and if the fire has occurred in a part of the building in which it is possible to confine the steam.

11. BLANKETING

Persons whose clothing is on fire should be made to lie down and should be covered with, or rolled in, a rug, coat, jacket, blanket, etc. If they are standing or running, as will often be the case, they should if necessary be brought to the ground. Persons burned in

this way should be kept wrapped up in the rug or whatever was used until they have been removed for medical attention. It is important to realise, however, that fire or sparks may continue to smoulder in the victim's underclothes and, if he or she is unconscious, may lead to further burning.

For dealing with fires such as those in cooking fats in small utensils, smothering with an asbestos blanket may prove effective, and where applicable has the advantage of obviating damage due to the use of water or chemicals. Asbestos blankets (see Part 1, p. 236) are installed in some premises, *e.g.*, in cinema projection rooms, for handling celluloid fires and for smothering fires in small containers of liquid such as paint or varnish pots (Fig. 17). The blanket should be opened out to its full extent, held more or less vertically in front of the operator and then swept over the burning material, working away from him, thus shielding him from the heat and flames. Alternatively, if a large blanket is being used on an open surface such as a vat or oil bath, it should be held by two men standing at opposite sides of the container

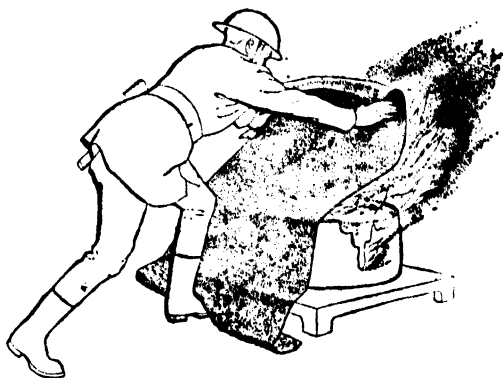


Fig. 17. Smothering a small fire with an asbestos blanket. Note how the fireman holds the blanket to protect his face and body from the heat.

and drawn slowly over the surface. When a fire has been smothered in this way the temptation to remove the blanket prematurely should be resisted or the fire may flash back again. The materials should always be given adequate time to cool. If no asbestos blanket is available it may be possible to make use of a doormat which has been wetted. Small fires in certain commodities can be extinguished by smothering them with the commodity itself. For example, this is often done with powdered sulphur.

It is occasionally possible to exclude the oxygen from a fire by mechanical means and allow it to burn out. Some types of vat are provided with lids which can be fitted for this purpose; fires in the machinery space of ships are also sometimes dealt with in this way.

12. BEATING OUT

Small fires in materials such as textiles, etc., may often be extinguished by beating them out or by rolling or screwing up the burning materials tightly to exclude the air. Beating is the method normally employed to extinguish heath, crop and other similar fires when water is not available (see the Chapter on "Fires in Rural Areas").

13. REMOVAL

When the fire in a room is on a very small scale the fireman should not overlook the possibility of removing the burning material from the room, using, for instance, an ordinary domestic dustbin or a bucket (Fig. 24). Care should be taken not to hold the container in such a way that the heated fumes rising from the burning material can reach the face, that other materials are not ignited on the way out and that the burning substance is placed where it will not endanger other property. If a small quantity of highly combustible material, such as a mattress or curtains, is burning in a room it may sometimes be advisable to throw it out of the window rather than carry it out through the house. Precautions should obviously be taken against any such material striking passers-by and arrangements should be made to extinguish it outside the building.

14. OTHER METHODS

Two methods used for checking the spread of fire are also available for use in highly specialised circumstances ; these are :—

(a) **Counterfiring.** Counterfiring is used in dealing with fires in forests, undergrowth, etc. (see the Chapter on "Fires in Rural Areas").

(b) **Demolition.** The use of explosives to demolish property to form a fire break has, from time to time, been suggested as a method of holding very large fires in check, and pulling down houses was, in mediæval times, a recognised method of firefighting. Under modern conditions, however, it is considered that demolition can prove of little value except in extremely rare circumstances. The reasons for this are several :—

(i) The use of explosives for demolition requires extensive training, and Fire Service personnel cannot be expected to possess the requisite experience nor would it be worth while to train them.

(ii) Assembling the necessary skilled personnel and equipment and preparing a range of buildings for demolition is a matter which may take several hours, so that either the fire will have spread beyond the proposed demolition line before the preparations can be made or the line must be fixed so far in advance of the fire that much property may be sacrificed unnecessarily.

(iii) It is virtually impossible adequately to collapse a well built modern framed building.

(iv) It is impossible to forecast the exact behaviour of the explosive, and party walls which might have formed an efficient fire break may be demolished.

(v) However great the precautions taken, there is always some risk to life.

(vi) With modern equipment for handling bulk water supplies, it should be possible to produce a water barrage which will stop the advance of the fire.

15. INSTALLED EQUIPMENT

It should be remembered that in most commercial or industrial premises, firefighting equipment will often be found already installed,

and may include buckets of water or sand, various types of chemical extinguishers, hose reels and hose cradles. Sometimes special extinguishers for dealing with the risks inherent in the processes carried on in the premises, such as carbon dioxide, C.T.C., and methyl bromide or special types of powder, may be found.

Whether or not such installed equipment will be used will depend on several factors. If it has been maintained efficiently, as will usually be the case where good fire protection and firefighting arrangements are in force in the premises, then considerable time may be saved by using it. The correct extinguishing medium will also be to hand, since this equipment will usually have been placed where it is likely to be required. In most large premises with private installations there is generally a plan of the installation showing the more important features, and this may be of value to the fireman.

On the other hand, it will not infrequently be found that such equipment is in poor condition and liable to fail at the time when most required. If the fireman knows his station ground he will usually appreciate whether or not the installed equipment in any particular building is likely to be reliable in use and whether or not suitable adaptors are available on the premises for connecting it if necessary to Fire Service equipment. The operation of such equipment is dealt with in the two Chapters on "Fixed Firefighting Installations."

Other things being equal, the Fire Service should as a general rule always use its own equipment. It is of interest to note that one of the largest fire departments in the U.S.A., which covers an area having many skyscrapers provided with an elaborate range of installed equipment, attaches great importance to the saying "We use our own pumps, our own water and our own hose."

(a) *Hose Reels, etc.* Nevertheless, the fireman should not overlook the possibility of making use of some types of equipment on the premises. For instance, the fireman should consider whether to use hose reels, internal hydrants or hose connected to risers installed on the premises, as this may remove the necessity for running out considerable lengths of hose from the street to the scene of the fire, thus reducing friction loss, lessening the amount of equipment needed and leaving the staircases clear of hose lines, which is important when people may be escaping from the building.

There is a practical difficulty in the operation of risers to which hose in cradles is connected, in that the risers are usually located on enclosed staircases and the whole of the hose must be pulled out and laid out without undue kinking before the water can be turned on. If, therefore, the branch is to be got to work close to the hydrant, a considerable length of hose must be disposed of on the staircase, thus adding to the handling difficulties. The most satisfactory method of disposing of this hose is, if possible, to expend the surplus by running it out up the flight of stairs and back down again. By this method, as the branch is advanced, so the hose can be pulled down off the stairs, the slope of which assists the branchman.

The tubing of hose reels is of considerably smaller diameter than

the hose in cradles, and consequently is suitable only for dealing with relatively small outbreaks. Tubing carried on reels possesses the advantage that it allows the water to be turned on irrespective of the amount of hose drawn off the reel, and there is no need to dispose of a possible excess of charged hose. In most models of hose reel, a valve must first be operated to charge the reel in addition to the control given by the shut-off nozzle.

Internal hydrants, which have been used in the early stages of a fire, are sometimes left open when the staff have been driven out of the building by spread of fire, and the consequent fall in the pressure in the mains may in certain circumstances hamper operations by causing a shortage of water. Should this occur, the master control valve, which is normally at the front of the building on the pavement or in the roadway, should be located and turned off.

(b) *Dry Risers.* When a serious fire occurs in a building fitted with dry risers they should be charged as a matter of routine, so that water is immediately available in the building.

ATTACKING THE FIRE

I. GENERAL CONSIDERATIONS

The necessity for getting some water (or other appropriate extinguishing medium) on to a fire at the earliest possible moment has already been emphasised in earlier sections, so that in this section a few general considerations only will be dealt with.

(a) *Action taken on First Entry.* A quick glance at any fire on enclosed premises, before the order "*Water on*" is given, will often reveal by the light of the fire the nature of the materials burning, their location and whether the fire is travelling up stairs, lift shafts, or into other rooms, etc.—important information which it is difficult to obtain once water has been applied to the fire, owing to the consequent increase in smoke and steam.

Men should not crowd into a small room. If two men can tackle the job, so much the better ; it reduces congestion and disturbance to the occupier.

Spare men should never crowd round doorways or on staircases, as by so doing they keep out fresh air from the men working inside and will be in the way should it be necessary for any reason for the men at the fire to beat a retreat. Moreover, when men are working under difficult conditions, it is an advantage to be able to arrange reliefs at intervals, and men who go to relieve those at the fire will be much fresher if they have been in the open air instead of immediately outside the room on fire.

(b) *Securing a Line of Retreat.* When taking hose through a doorway in a warehouse or other building containing quantities of stock, branchmen must see that as they work their way forward they do not let the fire get behind them. Unless they are careful it may travel unnoticed behind stock piles and reach the door, so cutting off retreat. It always pays to wedge open the door in such circumstances, the more so if it operates on a fusible link. Cases have occurred where doors of this type have operated and not only cut

off the retreat of the branchmen but severed the hose line on which they depended for their safety. The open door also serves to release some of the smoke and heat.

It is incumbent on an officer, when posting a party or directing them to take up a position, to see that their line of retreat is secured. The rapid advance of a roof fire may cut off men from the ladder by which access was gained to a roof, or means of retreat may be blocked by falling material (see Chapter 36, p. 169). It may sometimes be desirable to post a man to watch for dangerous conditions, or if men are working in smoke or darkness to place a lamp as a guide to the position of the doorway.

(c) *Working Conditions.* It will often be found that working conditions close to a fire, particularly at floor level, are considerably better than would appear when it is being approached, because the hot smoke and gases, as they expand and escape, tend to give a false impression of the conditions. Furthermore, in a confined space such as a room on fire, it is the first minute of attacking the fire which is the worst. When the jet first strikes the fire, large quantities of steam and often of smoke are formed which drive toward the outlet and, once this initial surge is over, conditions tend to improve considerably.

(d) *Water Supplies.* It will be realised that a main can only yield a certain quantity of water, and that if too many pumps are set into it the result will be that some will be starved. The obvious solution is to set into open water or mains of larger diameter, even though they may be some distance away. It is in such cases as this that a good knowledge of the lay-out and capacity of the local water supplies will prove invaluable to the Fire Service officer. In most towns the water supplies to certain areas are inadequate for firefighting, and if a call is received to such an area it is desirable to arrange for the dutyman at the fire station to request the Water Authority to take such steps as are possible to improve supplies on the fireground.

The diversion of water for firefighting purposes is covered by paragraph 14 (3) of the Fourth Schedule of the National Fire Service (General) Regulations, 1944,* which states :—

The officer of the National Fire Service who has charge of the operations for the extinction of a fire may require the water to be shut off from the mains or pipes in any area in order to give a greater supply and pressure of water for extinguishing the fire, and no authority or person shall be liable to any penalty or claim by reason of the interruption of a supply of water occasioned only by compliance with a request or requirement of an officer of the National Fire Service that the water shall be shut off from the mains and pipes in any area in order to give a greater supply and pressure of water for extinguishing a fire.

(e) *Siting Pumps.* The correct siting of a pump is always a matter of some difficulty, since it will be influenced by numerous factors, the more so if, for any reason, it is necessary to fight more than one small fire with a single pump, a situation that might arise in a rural area. The two principal considerations which govern the siting of a pump are irreconcilable. Efficient control on the

* Statutory Rules and Orders, No. 1077 of 1944.

fireground demands that the pump should be located as close to the fire as conditions permit, for this allows relatively short hose lines to be run out to the branches, reduces friction, economises in hose and facilitates the passing of messages between branchmen and pump operator. On the other hand, to obtain the maximum quantity of water from any hydrant, the pump should be placed as close to it as possible. If, therefore, the nearest hydrant is some distance from the fire, a decision will have to be reached as to whether the pump should be sited close to the fire, and water run to the pump from the hydrant through long lines of soft suction, or whether the pump should be placed near the hydrant and the length of the hose lines to the branches correspondingly increased.

If the pressure in the mains is high, then ease of control may compensate for hydraulic inefficiency, and it will be preferable to employ several lines of soft suction working into the collecting head of the pump. It should be appreciated, however, that it will be necessary to employ at least as many, and preferably more, lines to feed the pump than are to be got to work from the pump. If the pressure in the mains is relatively low, however, it will be incapable of providing the necessary energy to overcome the friction loss in long lines of soft suction, and hence the quantity of water reaching the pump will be insufficient to yield adequate firefighting jets.

In most cases a pump is capable of generating a far greater pressure than can be obtained at the hydrant outlet, and it will, therefore, in general be found preferable that a pump should be utilised to provide the necessary energy to force the water to the fireground in preference to relying on the hydrant pressure. If additional pumps are available, it is, of course, always good practice to place a pump as close to a fire as possible and to feed it by a modified form of collector working from other pumps.

2. PREVENTING FIRE SPREAD

There are four ways by which fire can spread :—

- (a) convection ;
- (b) conduction ;
- (c) radiation ;
- (d) direct burning, which is a combination of the previous three methods.

In practice, the first and last methods are the most important, although all four play a considerable and largely interdependent part in the spread of fire.

(a) *Convection.* Since smoke and heated gases tend to rise (Fig. 18) they will find out any openings in horizontal surfaces which permit them to escape. The natural path of travel is therefore vertically above the seat of the fire until the smoke and hot gas or flame reaches the ceiling, when it will mushroom. If there are open doors, transom lights, ventilation ducts, holes for pipework or cable ducts, the smoke, etc., will escape through these until it reaches a staircase or other opening in a horizontal surface. Such

paths may be direct openings like lift shafts (Plates 1 to 5, facing p. 28) and stairwells of all types, trap-doors, skylights, belt races or conveyors; or partially or wholly enclosed openings, like overhead bridges spanning between adjacent buildings, ducting for ventilation, heating, dust or fume extraction, etc. Where pipework, etc., passes through from one floor to another, there may be a bad fit and gaps may allow sufficient space for hot gases to filter through in quantity. The later and more detailed size-up of the situation will, therefore, include a quick recognition of any such features which may allow the fire to spread to adjoining compartments, either laterally (Plates 6 and 7) or vertically.

The influence of windows on the spread of fire is of particular importance, for heat rapidly shatters unprotected glass and allows the flames to escape and curl up into the windows on floors above (Fig. 19 and Plate 8), sometimes even missing a floor. On the other hand, wired glass is a first-class reducer of fire spread, and wired glass panes in metal frames will hold back even a relatively intense fire for a considerable period. Materials in adjacent rooms or buildings can be ignited by heat or flames passing through windows which are open or break with the heat, and party walls cannot be relied on to provide a fire break if flames can pass round them (Plate 9).

(b) *Conduction.* Most metals are good conductors of heat and, therefore, the ends or sides of all joists, piping, shafting and other similar objects outside the affected compartment which might transmit the heat of the fire to adjacent compartments, should be

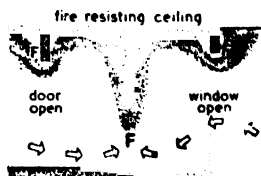
FIRE IN THE OPEN AIR

Cold air ($\Rightarrow \Rightarrow$) is drawn into the fire F by up-rising smoke and hot gases ($\Rightarrow \Rightarrow$)



FIRE IN AN OPEN ROOM

Cold air ($\Rightarrow \Rightarrow$) is drawn in through the bottom of the door and the window. Hot gases mushroom out on ceiling and escape through the top of door and window openings starting small fires (F F) in the woodwork.



FIRE IN A CLOSED ROOM

The hot gases ($\Rightarrow \Rightarrow$) mushroom against ceiling. They are cooled and drop to the floor when they are again drawn into the fire and the process repeated until the whole room is heated up.



Fig. 18. Diagram showing the principles of fire spread by means of convection.

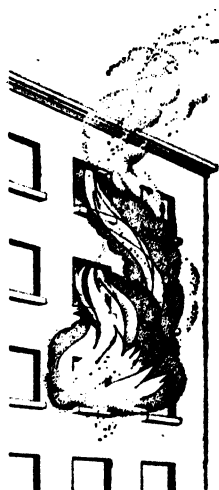


Fig. 19. Showing how fire can spread from floor to floor by way of windows which are open or which have been broken by heat.

carefully inspected. Central heating or machinery, for instance, is often installed long after the building was completed, and openings for the pipes or shafting may be cut through walls which were originally designed as fire walls. Such pipes do not present a great hazard if they are well away from all inflammable materials, but this is rarely the case, for goods are frequently stacked on or against them, whilst central heating piping, being carried close to the walls or under the floors, is nearly always close to timber and dust in floors or skirtings. Pipes for steam heating present a greater hazard than those used with low pressure hot water.

Machinery shafting may cause fire spread, for it may be suspended from wooden roof members in bearings which transmit the heat and ignite the wood. Further, the bearings are usually copiously lubricated, and large oilers may contain sufficient oil or oil-soaked dust and cotton waste to catch fire and subsequently fall to the floor, or alternatively to involve the roof structure above.

Much the most common cause of the spread of fire by direct conduction, however, is through steel beams and joists forming part of the structure of the building. In large numbers of premises these beams are exposed, and hence are capable of receiving and transmitting any heat generated in the compartment in which they are situated. Thus in multi-floored buildings having a steel frame structure with brick panel walls, the walls themselves may resist the transmission of heat, but any exposed steelwork will act as a good conductor and ignite inflammable materials in adjoining compartments.

On the other hand, steelwork which has been encased in brick or concrete (Plate 10) can withstand a considerable amount of heat before it is affected by the fire, and before it will conduct heat into adjoining compartments in this way. The encasing of the steelwork tends not only to prevent it heating up when surrounded by fire, but also to confine any heat it may have gained, and thus to prevent it from igniting materials in a compartment otherwise unaffected.

Fire-resisting doors are so constructed that, should a fire occur on one side, the other side does not attain a temperature sufficient to ignite material in contact with it. Occasionally, however, fire does spread through an opening protected by a fire-resisting door because the door is faulty, but much more often because of gaps around a badly fitting door. Whilst a fire-resisting door will usually form an effective fire break, a careful inspection must always be made of the far side to see that fire has not broken out there, due to a door having been left open or through occupiers stacking goods too close to the door (Plate 11). The solid iron doors which are sometimes found in commercial premises should not be regarded as being necessarily fire-resisting and should be carefully watched, since they may buckle with heat and thus allow the flames to pass through the resulting gap between door and jamb.

(c) *Radiation*. The transmission of heat by radiation is entirely independent of air currents or a material path for the heat waves. Thus the heat received by the earth from the sun is entirely in the form of radiation and, as is well known, the sun's rays can ignite

combustible materials, especially if concentrated by means of a magnifying glass.

Radiation is a potent cause of fire spread when it has attained any magnitude, and is a very frequent cause of a serious fire "jumping" from one side of a street to the other. The intensity of radiation diminishes rapidly with distance, so that an open space of sufficient width is the most effective type of fire break.

Radiation may often be of sufficient intensity to ignite the woodwork of windows or doors (Plate 12), and to break windows in exposed property and hence permit the entry of heat and flying brands. Radiant heat can also pass through windows without breaking them and cause a fire within. Classic examples of this are the fires which occur from time to time as a result of the concentration of the sun's rays through the bottles of coloured water found in chemists' windows or through carafes of drinking water. Fires have also occurred as a result of celluloid objects in shop windows being ignited by the sun's rays passing through the windows.

If radiant heat from a fire falls on a vertical surface of slate which has been nailed in position or fixed with lead clips, the heat may crack the slates, allowing them to fall away, or melt the lead clips, with the same result, thus exposing the timber battens on to which the slates are fixed to the full effects of the radiant heat, with the result that unless they are cooled they will in all probability ignite. Radiant heat may also soften or melt the lead in the leaded glass windows which are frequently used for decorative purposes, so allowing the glass panels to fall out.

(i) *Water Curtains*. The effects of radiant heat can be countered by forming a water curtain between the burning building and that to be protected. The water spray and the steam so formed (Plate 13) absorb a considerable proportion of the radiant heat, and the building to be protected is also cooled to below the ignition temperature of any exposed combustibles. Every endeavour should therefore be made to keep the whole of the surface of an exposed building cool.

(ii) *Drenchers*. Drenchers are fitted to protect the openings in the face of a building which are particularly vulnerable to radiated heat (see the Chapter on "Sprinklers, Drenchers and Water Spray Systems"). Where such equipment is installed, the Fire Service officer should make every effort to get it into operation if it will assist in preventing the spread of the fire. Such a system will normally protect the building better than can Fire Service branches, and will release personnel for other duties more directly connected with fire extinction. A large drencher system may, however, cause a serious draft on the mains, and the officer in charge of the fire should bear this in mind when he is planning the best use of his available water resources.

(d) *Direct Burning*. Although this is really a combination of all three processes of convection, conduction and radiation, it is convenient to treat it as a separate process for the purpose of this chapter, since it is the most usual method of fire travel.

(i) *Fire-resisting Walls*. It is to prevent the spread of fire by direct burning that most property is isolated into sections by fire-

resisting walls. A fire-resisting wall is one which is, or can be, completely closed against direct communication of fire from one side to the other. Party walls (*i.e.*, the dividing walls between adjoining buildings as defined by the Building Acts) should normally fall into this class, but owing to deterioration due to the age of a large proportion of the buildings in this country and to lax methods of building in the past, they frequently do not fulfil this requirement.

Thus in older buildings, wooden beams or roof timbers may run right through the party walls from one side to another, or the ends of the timbers of two adjacent houses are only separated by a few inches of brickwork in which the mortar may be cracked, so allowing the fire to pass.

(ii) *Concealed Spaces.* Direct burning is the principal method of fire spread in partitions (Fig. 20) and concealed spaces (Plate 14)

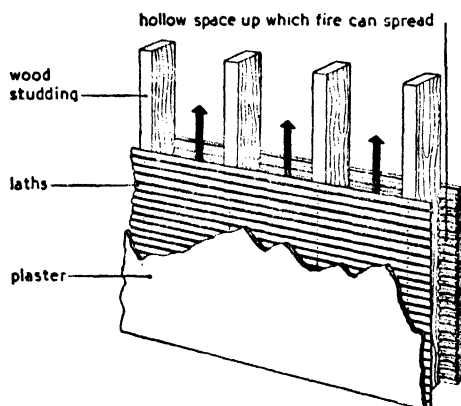


Fig. 20. Sketch showing the construction of a hollow partition and the spaces up which fire can travel undetected. These spaces form excellent flues and can allow the fire to travel with considerable speed. Alternatively the hollow space may sometimes be packed with inflammable filling such as sawdust or wood-wool.

generally. Hollow partitions may, very occasionally, be found extending through more than one floor, but are not frequently so employed because they cannot be used to support any load. They are usually found in adapted property as, for example, in cases where a high-ceilinged room has been divided into two by inserting a false floor. It is essential to feel carefully for heat both above and below the fire if it is suspected that such a partition may have become involved.

Hollow partitions will sometimes be found packed with straw, sawdust, shavings, etc., but this type of construction is more usually associated with heat or sound insulation (Plates 15 and 16). Whilst fire will continue to spread through this type of construction till it is checked, the spread, whilst more intense, is not usually so rapid as through hollow partitions, where a free current of air can carry the smoke and heat with great speed.

Systematic feeling of walls, skirting boards, etc., gives a good indication of the extent of fire travel in concealed places. By feeling the hottest parts at frequent intervals to ascertain whether they are cooling down, it is often possible to determine with some degree of accuracy whether there is fire behind them. Heat may



Plate 17. This photograph gives an excellent impression of the effect of a serious fire on unprotected steelwork. Failure was doubtless assisted by the heavy machinery which was installed in the building, some of which can be seen lying in the left-hand corner.

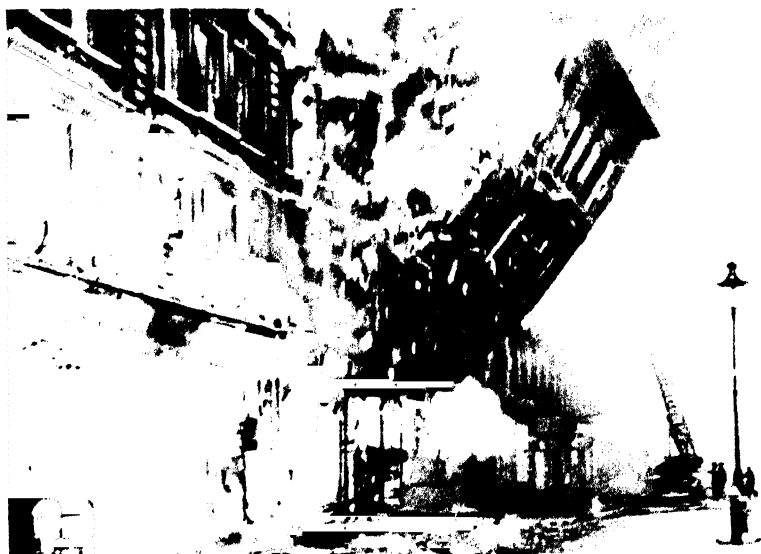


Plate 18. A unique photograph showing the behaviour of a wall at the moment of its collapse.

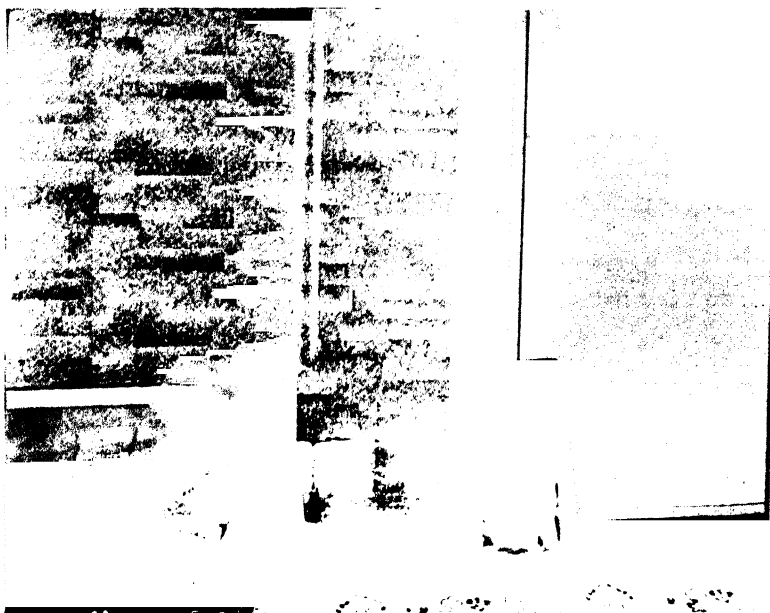


Plate 19. Photograph showing a skirting board fire caused by the ignition of a wooden plug inserted into the 4½-in. brickwork of the flue. This plug ignited and set fire to the skirting board. Note how, by careful use of tools, it has been possible to remove the boards with virtually no damage to the woodwork.



Plate 20. Photograph showing the results of a fire caused by the ignition of a timber beam set into a chimney breast. The beam marked "A" has been partially burnt away.



Plate 21. An excellent example of how defective building construction can cause an outbreak of fire. Note how the woodwork has been set into the brickwork of the chimney, one flue of which can be seen to the right. Defective mortar allowed heat from the chimney to reach the rafter, which was subsequently ignited, and this in turn led to a fire which destroyed the top floor of this building.



Plate 22. Photograph showing the pans in a fish frying shop. Behind can be seen the ducts through which fire spread to the rooms above (Plates 23 and 24). The hoods have been removed to expose the entrance to the ducts.



Plate 23. The room above that shown in Plate 22. On the right-hand side can be seen the sheet metal duct through which fire spread from the fish pans below. The wallpaper and sheeting to the duct have been removed. On the left-hand side near the gas bracket can be seen a second duct serving another flue.



Plate 24. The floor above that shown in Plate 23. Note how the two ducts meet and how the fire has increased considerably in intensity at the bend, as shown by the considerable depth of charring in the woodwork and discoloration of the sheet metal.

often cause discoloration of plaster or wallpaper and smoke will frequently ooze through cracks in the plaster itself.

Where any doubt remains, small portions of the partition, skirtings, etc., should be carefully cut away in order that proof may be obtained whether there is fire in any concealed place. It should be realised, however, that in a room where fire has occurred, the plaster of lath and plaster walls may be too hot on the surface to be touched by the bare hand but the lath behind may be unaffected by the fire and much unnecessary damage may be caused by cutting away indiscriminately instead of ascertaining definitely whether there is or is not any concealed fire. The presence of cobwebs is a reliable indication that fire has not passed the point at which they are found.

In old buildings there will usually be loose boards where electrical wiring or gas piping has been installed, and these can often be lifted with little trouble when looking for the spread of fire under floors, etc.

(iii) *Ducts, etc.* Careful consideration should always be given when introducing water into a duct, as it may be carried for considerable distances and damage may thereby be caused.

(iv) *Flying Brands.* Flying brand hazards are the result of convection currents and direct burning. The uprush of heated air above the fire carries small pieces of flaming material sometimes to a great height, and any wind there may be drives them to considerable distances. Such brands alighting on inflammable material will ignite it, and thus, in the vicinity of a large fire, occupiers of premises should be warned to keep a careful watch on all points where further outbreaks might develop.

A considerable danger arises from the brands being carried into open windows, and all residents in the vicinity should therefore be requested to shut their windows. In the case of unoccupied property firemen should be detailed to shut open windows or, if they are broken, to patrol with a hand pump those parts of buildings which might become involved through flying brands.

3. EXPLOSION RISKS

A serious danger with fires in certain types of premises is the risk of explosion, which may be due to :—

- (a) dangerous gases evolved in the course of combustion of the materials on fire, or town or other gas escaping from fractured or burst pipes ;
- (b) the nature of the contents.

(a) *Dangerous Gases.* The dangers from unburnt products of combustion are dealt with in Part 1, p. 30, under the heading "Back Draught." It is sufficient to emphasise here that care must always be taken in opening up a room or compartment in which a fire is believed to have been smouldering for some time, or if substances such as celluloid or burning bituminous insulation have been involved.

Escaping gas forms the other major explosion hazard. Gas

escapes may be due to a variety of causes, usually the fracture of a pipe through a settlement in the premises caused by the fire, by expansion or contraction of the pipes due to heating or cooling or by the melting of the lead pipes by which gas meters are usually connected into the system. In this last case, however, the escaping gas will normally ignite and will not therefore cause an explosion danger. In some industrial premises where large scale welding operations are carried out, fixed acetylene plants are installed, and this gas may also be found occasionally for illuminating country houses. Escapes of acetylene due to fractures in the pipework, etc., may therefore lead to explosive concentrations, since the explosive range (see the Chapters on " Fires in Gas Undertakings " and " Special and Unusual Risks ") is very great.

(b) *Nature of Contents.* The nature of the contents of industrial premises will vary greatly, and it is impossible to do more than touch on a few of the points to which consideration should be given.

(i) *Dust Explosions.* As was pointed out in Chapter 1, certain combustible substances, of which flour and starch are outstanding examples, when in a fine state of division are capable of behaving like gases and giving rise to serious explosions (dust explosions) when mixed with air in the correct proportions and ignited (see the Chapter on " Special and Unusual Risks "). Where there is any such possibility, operations should be carried on in such a way as to disturb the powdered material as little as possible. In particular, jets from branches should not be allowed to strike the finely divided material so as to stir up dust clouds, and diffuser branches should be used to attack the fire and damp down any dust which might otherwise fly. When explosive conditions are believed to be present, branches should be laid out to cover all possible ways of spread and then every available aperture in the building should be opened to vent any possible explosion.

(ii) *Protecting Sealed Containers.* When considering the siting of branches, adequate provision must be made for the protection of any surrounding hazardous commodities. Thus in premises where compressed gas cylinders (oxygen, acetylene, etc.) or sealed drums of liquid are stored, there is always the danger that the heat of the fire might raise the temperature of the cylinders or drums sufficiently to cause the contents to burst the container. This also applies in the case of empty drums which have contained inflammable liquids or the petrol tanks of motor vehicles. To guard against this water must be applied liberally as a spray, or as a jet where it is impossible to get within close reach.

On the other hand, water should be kept off the hot fronts of boilers or pipes carrying superheated steam, for the sudden cooling might cause a fracture with the consequent release of large quantities of boiling water or steam.

4. DANGEROUS FUMES

In certain types of industrial premises, dangerous gases or fumes may also be encountered. These may be poisonous, such as chlorine ;

inflammable and explosive, such as hydrogen ; or corrosive and evolving dangerous fumes, such as hydrochloric or nitric acids. Contact with the appropriate official of the works will ordinarily produce information as to the presence and nature of such materials. Carboys, particularly if half empty, also constitute a hazard and, in general, they should not be moved unless it is absolutely necessary, since the risk of danger from breakage is probably greater than that from the fire. If the carboys have to be moved and the wicker or iron handles appear at all unsafe, it may be advisable to make a rope fast round them and drag them away. Alternatively, a plank may be used like a stretcher to carry them. It should be remembered that since they are of glass they will probably break if they are dropped, and release their contents, which are often of a dangerous nature. (The more common hazardous commodities likely to be encountered under this head are dealt with in the Chapter on " Special and Unusual Risks.")

5. AVOIDING COLLAPSE OF BUILDING

(a) *Overloading.* Throughout firefighting operations it will be necessary to maintain a close watch to ensure that dangerous conditions which might lead to the collapse of the building are not set up. For instance, heavy machinery on the upper floors of a building is liable to prove a great danger in the event of weakening of the walls or supports and water should therefore be got away from upper floors as soon as possible. Even a few inches of water spread over a large floor area may represent some tons in weight and, together with the merchandise already stacked there, may in some instances load the structure beyond its capacity.

A detailed account of the various methods of getting water away from a burning building is given in Chapter 38. In exceptional circumstances, however (*e.g.*, in certain categories of cotton warehouse), it may be desirable to arrange to cover the floor above the fire with a thin sheet of water to prevent the spread of fire upwards.

(b) *Expansion.* Water played on to absorbent substances represents a twofold risk ; first, that it will cause them to expand considerably and, if they are tightly packed, force out the walls or displace columns and, second, that all water so absorbed cannot be cleared and is added to the floor loading. Of these substances, the most important are tea, hops, cereals, many forms of textile fibres (wool, hemp, jute and rags), paper and wood pulp.

(c) *Symptoms of Collapse.* The first signs of impending collapse of a building (Fig. 21) are often the fall of pieces of mortar, stone, etc., from the walls. These are often accompanied or followed by leaning or bulging, and when this symptom occurs collapse may then be presumed to be imminent. Leaning or bulging can often be detected by going to one end of the building and looking along the face.

In assessing the probable tendency of a wall to collapse, consideration should be given to its apparent age, to the condition of the

mortar, to the intensity of the fire and to the length of time it has been burning. Points to watch are long stretches of wall which are not keyed to cross walls at intervals and which are relatively thin in relation to their height.

Walls may fail, in buildings having steel joists, through the expansion of the joists pushing the walls sufficiently out of the

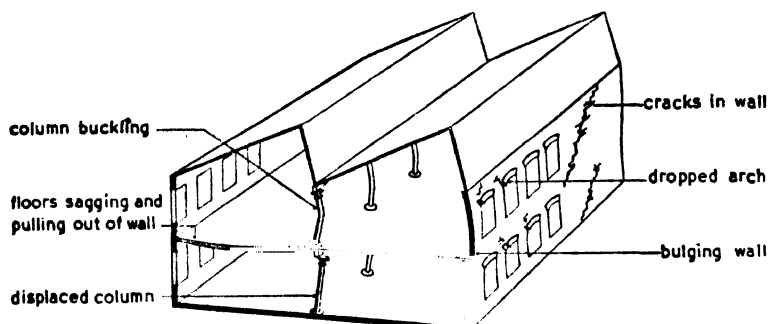


Fig. 21. Diagram showing (greatly exaggerated) some of the more usual signs of collapse in a building.

perpendicular to cause them to collapse. Sometimes, however, the result of the expansion is to punch a hole through the brickwork lying at the end of the joist. If, on the other hand, the wall does not collapse, the joists will contract when they are cooled through the application of water or through the extinction of the fire and, since the walls will not also return to the perpendicular, the shortening of the joists may cause them to fall off the wall plates and thus cause the collapse of the floors.

Stone walls, especially those made of granite, sometimes give relatively little warning of impending collapse but, since they are very robustly constructed, they are only likely to fail if the fire is serious.

Cracks appearing in a horizontal line over windows and doorways are usually more indicative of danger than vertical cracks. Unprotected steelwork is very vulnerable to the effects of high temperature, and cases have been recorded of the collapse of a complete steel-framed building (Plate 17, facing p. 44) through the distortion of exposed steelwork, after a relatively short exposure to the fire.

Walls will usually fall outwards (Plate 18), but may be brought down inwards, particularly by the collapse of one or more floors. At fires of great intensity, such as those involving heavily stocked rubber warehouses or furniture depositories, where it is considered possible that a wall may collapse, appliances should never be placed where they would be endangered. The corners of a building will be the safest points from which to work.

In premises with load-bearing walls, a considerable measure of stability is given by the support of the floors, and if these have collapsed, the walls will be weakened, and should then (unless they are unusually thick) be regarded with suspicion.

The principal signs of collapse of a building may be listed as :—

(i) Cracked or dropping arches over doors, windows and other openings.

(ii) Spalling of stonework, falling of cornices, etc., particularly on buildings with heavy facings of ornamental stone.

(iii) Sagging floors or beams or gaps between the edges of floors and the walls.

(iv) Displacement of steel or cast iron pillars supporting joists or beams.

Immediately an officer is satisfied that the signs are such that collapse is probable, he should not risk the lives of his men, but should order them out clear of danger.

6. DEALING WITH OCCUPANTS OF PREMISES

When entering a private house to deal with what is obviously a small fire, the fireman should be considerate to the occupants in what is for them a time of stress. He should avoid carrying unnecessary dirt about on his boots and should not stand on furniture without first covering it up. Whereas a fire in a private house is to the fireman a technical problem, it is to the occupants a misfortune involving sentimental and financial considerations. In addition, the suddenness with which a fire occurs may lead, particularly at night, to a certain amount of shock, causing over-excitement and even hysteria. Occupants so affected should be dealt with firmly but sympathetically.

If the occupiers are particularly concerned about any object of intrinsic or sentimental value, a special effort should be made to meet their wishes, provided that firefighting considerations are not affected. No one should be allowed to remove materials from the premises unless the Fire Service officer is satisfied that they are in fact the owners. Any money found should be counted in front of a witness, and valuables found during operations should be handed over to the owner or, if he is not available, to the Police and a receipt obtained for them.

As soon as it is safe, occupiers should be allowed to enter their home and any reasonable steps taken to assist them, unless there is reason to suspect arson, in which case the Police should be consulted before anyone is allowed to enter. The Police should, of course, be asked to cope with any particularly difficult persons.

The obstruction of a fireman in the course of his duties is an offence, and the Police can, if necessary, take action under paragraph 14 (2) of the Fourth Schedule of the National Fire Service (General) Regulations, 1944,* which states :—

Any person who wilfully obstructs or interferes with any member of the National Fire Service engaged in operations for the extinction of a fire or the protection or rescue of any person or property from fire shall be liable on summary conviction to a fine not exceeding ten pounds.

DEALING WITH SPECIAL FIRES

It is impracticable in this *Manual* to deal with the innumerable classes of fire with which the fireman may, at some time in his life,

* Statutory Rules and Orders, No. 1077 of 1944.

be faced. Hints on a few of the more usual types are given as showing the general principles on which they may be dealt with.

I. BASEMENT FIRES

Since basements are almost without exception ill-ventilated, basement fires are often smoky and unpleasant to deal with. There is also the possibility of carbon monoxide being present, and breathing apparatus, therefore, should always be considered as a possible aid. The first step in dealing with a basement fire should be to find out how many basements there are. Many buildings have both basement and sub-basement, and it is not unusual to find that basements are common to, or communicate with, more than one of the adjacent buildings. The atmosphere at the entrance to a basement fire is nearly always far hotter than the air at floor level in the basement, and if the fireman can once force his way down past the heat he will find conditions there more bearable.

Immediately branches are in position to cover any possible spread, every effort should be made to ventilate the fire by opening up pavement lights, etc. Basements in large buildings may have several entrances, and though it is obvious that every possible entry should be used in an endeavour to get at and attack the fire, it will generally be found preferable to attack the fire from one opening and allow the heat and smoke to escape from the others. Opening up will greatly assist in venting the smoke and heat, but adequate precautions must be taken against the spread of fire to upper floors through the windows above.

Pavement or stallboard lights should be removed or, if this is impossible, broken open, whilst in many old premises used for storage, entrance may be gained through the cellar flaps which open up on to the pavement.

(a) *Covering Openings.* A basement fire, unless it is skilfully handled, may spread with great rapidity up the building by way of lift shafts, staircases and other openings in horizontal surfaces. This is well illustrated in Plates 1 to 5, which show a fire which spread from the basement up a lift shaft, resulting in the burning out of the top floor, although intervening floors were almost unaffected. Branches should always be arranged at ground floor level or at openings leading from the basement to cover any shafts up which the fire might spread.

When a fire is being fought in upper floors, the fact that burning debris may fall down lift shafts, light wells or other vertical openings and start fires in the basement should not be overlooked. It will often be a wise precaution, therefore, to lay out hose lines to cover the foot of any such openings, so that incipient fires can be dealt with immediately. Once all openings have been protected in this way, it is essential to open all windows on the floors above the fire so as to prevent the building from becoming smoke logged, and to institute a regular patrol to deal with or give notice of any outbreak which may develop on upper floors.

(b) *Fighting from Above.* If it is not possible to get into the basement, even when using breathing apparatus, it will be necessary to

consider other methods of fighting the fire. In fires of this type the revolving nozzle, cellar pipe, basement spray, elbow-for-nozzle, two-way branch and similar equipment (see Part 1, p. 80 *et seq.*) may be of considerable value. After estimating the approximate position of the fire, a hole should be cut in the floor through which to introduce the nozzle, so that the jet or spray will strike the fire.

If such equipment is not available, it may be possible to use a branch directed by means of a line (see Part 3, p. 131), or to improvise some form of cellar branch by using a double or single outlet standpipe head into which ordinary branches with the appropriate size nozzles have been connected. Alternatively, a diffuser branch adjusted, before being lowered down into the basement, to give a spray at a suitable angle, may be employed. The floor from which the fire is being fought should be ventilated by opening up all windows and doors and the hole which has been made should be covered with the necessary branches.

(c) **Smoke Exhausters.** If the fire is of a very smoky nature and a smoke exhauster (see Part 2, p. 170) is available within reasonable distance, it should be ordered on, as the appliance may assist materially in improving working conditions and clear the compartment sufficiently of smoke to enable men to see what is happening. It should be remembered, however, that its use may serve to stir up and drive the fire, so that discrimination will have to be employed unless the fire is so covered that it cannot spread. Wind sails have occasionally been effectively employed to remove smoke from a basement.

It should not be forgotten that the basements and sub-basements of some buildings of modern construction can be ventilated by smoke extracts, consisting of shafts leading from the basement or sub-basement to the open air. Inside the basement the shaft is open, but it is protected at ground level by what resembles a pavement light which can be opened from the outside by breaking one of the glass panels (usually coloured red) and releasing the catch within. When smoke extracts are fitted to both basement and sub-basement, those from the latter pass through the basement without communicating with it. Smoke extracts are marked by means of small plates located usually just above them with the words "smoke extract to basement" or "smoke extract to sub-basement," as the case may be.

(d) **Flooding.** The necessity for flooding a basement when all other means have failed is dealt with in Chapter 33, p. 85.

(e) **Small Fires.** Smoke emerging from a basement which is fitted with pavement lights having small ventilating holes may sometimes be traced to burning materials in the save-all trays which are fitted below such holes, or to dust, etc., on ledges below the lights, which has been ignited by a carelessly discarded cigarette end or match.

2. CHIMNEY FIRES

Chimney fires can lead to serious results, particularly in old houses, and their successful extinction is often a long and difficult

task. It should be remembered also that more chimney fires are attended than any other single type (in some areas as many as one-third of all calls are to chimney fires), and that the Fire Service comes in contact with the public over this type of fire more than any other. The efficiency and consideration shown by the Service is therefore frequently judged by its method of dealing with chimney fires, and every effort should be made to extinguish each individual outbreak in the manner which will cause the least damage and inconvenience to the occupiers.

The technique employed for extinguishing chimney fires varies in several parts of the country, but the more common methods are given below. The particular method to be adopted will depend upon the circumstances of the case. Thus a fire low down in the flue would normally be tackled from the grate and one at a higher level from the roof. There is seldom any great urgency when dealing with these fires, and impulsive and hasty action should be avoided. It is best to consider the situation carefully and decide upon a definite plan of action before making any attempt to tackle the fire. The four principal methods employed are :—

- (a) attacking from the grate ;
- (b) attacking from the roof ;
- (c) attacking either from the soot door or register plates in the chimney breast or at intermediate levels ;
- (d) letting the fire burn out.

(a) *Attacking from the Grate.* This is usually the simplest and quickest method, particularly in the short and straightforward flues found in dwelling-houses of two or three storeys only, and is likely to result in less damage than other methods. The affected grate can usually be ascertained without difficulty from the particles of burning soot falling into the room or from the roar in the chimney.

When the fireplace has been identified, the first action should be to clear away rugs, carpets, etc., from in front of the fire, to clear the mantelpiece and push any furniture to the side of the room farthest from the fireplace, and if possible to cover it. A dam should then be made in front of the fireplace with sacking, rags, soaked newspaper or any other convenient material, to contain any water or debris which may fall from the flue. A little water should then be applied to the fire. This will cause steam to rise and will often of itself extinguish the fire in the flue. If a damper is fitted, this should be opened to its fullest extent to create a good updraught, which will draw the steam into the flue. If this is not successful, then the use of a hand pump or hose reel may be necessary.

Before this is done it should be decided whether or not the fire in the grate is to be withdrawn. Working up the flue will be very much simplified if this is done, but many officers consider that it is best to leave the fire in, since any water falling back from a chimney will cause steam which will help to extinguish the fire. It is advisable, before using a jet up the chimney, to examine the flue in order to ascertain, if possible, where the pocket of fire may have

lodged. The best way to do this is to use a mirror (any household mirror will serve), since the falling particles of the burning soot may cause eye injuries if any attempt is made to peer up the chimney.

If the seat of the fire can be found and is within a short distance of the grate, a jet from a hand pump may be sufficient to extinguish it. If it cannot be found, or it is a considerable way up the flue, chimney rods (see Part 1, p. 249), a broom handle, or any long rigid object which can be pushed up the chimney will have to be employed. The nozzle of the hand pump or hose reel should be lashed to the upper section of the rods and pushed slowly up the chimney, water being pumped through at such a rate that the greater part of it is vaporised, the steam so formed helping to blanket the fire further up the flue. If a rose nozzle or other form of spray is available, this should be employed, since water is then evenly distributed round the inside of the flue. Except in long or tortuous flues, these methods will usually result in the rapid extinction of the fire.

Simple chimney fires can sometimes be extinguished from the grate by excluding the supply of oxygen to the flue. Some fireplaces are fitted with a register plate (marked A in Fig. 28 above), which can be pulled down so as to close the chimney completely. When this is possible, with a well-built flue designed to modern standards, it will often be successful, but will seldom avail in houses of old or faulty construction.

In some parts of the country chimney fires have been extinguished by pushing a sweep's brush or other large object either up or down the chimney, but this method is not recommended, since it may cause loose or faulty brickwork or pargetting to become dislodged and so cause a blockage in the flue. There is also a danger that dislodging the pargetting in this way may cause the ends of wooden joists or beams to become exposed, and these may subsequently char and cause a more serious outbreak.

Attacks from the grate may sometimes be rendered difficult by the fact that an oven has been installed, and this will have to be removed before the fire can be tackled. Such ovens are usually held in position by a single large wing-nut inside the oven at the back and can easily be removed once this has been released. If a kitchen range is fitted, there is usually a register plate (Fig. 22) or other inspection orifice fitted above the range through which a jet can be inserted.

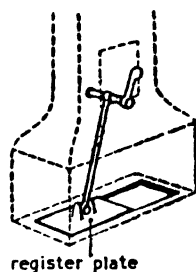


Fig. 22. Diagram showing how the flue above certain types of domestic range can be shut off by means of a register plate.

(b) *Attacking from the Roof.* If the fire is located in the upper part of a long flue, attack from the roof will often prove the only means of extinguishing it. Before attempting to deal with a chimney fire from the roof, however, every effort should be made to ensure that the correct chimney has been found. Instances have occurred

in which the wrong flue was attacked—with unfortunate consequences to the contents of the room served by the chimney. Some of the various methods which can be employed to identify the correct chimney are as follows:—

(i) It will usually be possible to identify the correct stack or group of chimneys without any difficulty. When this has been done and access to the stack has been obtained, the most elementary

method of identifying the correct chimney is to place a hand over each chimney in turn, when the chimney on fire will usually be indicated by great heat. Failing this, it will be found that the one which is on fire will blacken the palm. (This method can also be used to test whether the fire has been extinguished.) Where fires are burning in other grates the same symptoms will, of course, be apparent. It may very occasionally be found that two fireplaces are served by a single divided flue (Fig. 23, right). This state of affairs can be immediately detected by counting the number of fireplaces in the house, and then the number of chimneys. If there are fewer chimneys than fireplaces, then one or other of the flues will be divided. In such cases it will still

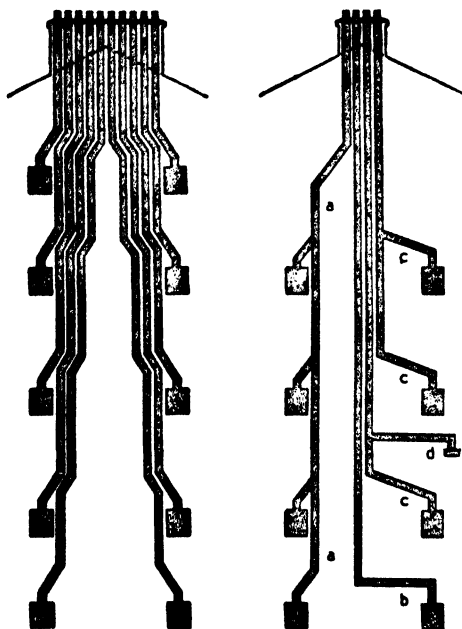


Fig. 23. Left : good arrangement of flues to fireplaces. Note that each fireplace has its own flue and that all bends are constructed so that pockets of soot cannot lodge in them. Right : bad features in chimney design showing (a) one flue serving several fireplaces; (b) horizontal bend in which soot can collect; (c) flues with insufficient slope; (d) flue subsequently constructed to take a domestic boiler.

be possible to ascertain which flue is affected, but special precautions against damage must be taken.

(ii) Apply water to the affected grate, when the rising steam from the chimney will reveal which is the correct one.

(iii) Burn a smoke-producing agent, such as brown paper or oily rags, in the grate, and the smoke so produced will emerge from the affected chimney.

(iv) Call up the chimney from the affected grate.

Once the correct chimney has been identified, the fire should then

be attacked with buckets of water, a hand pump or hose reel equipment, after the precautions against damage to the contents of the room described in section (a) above have been taken. They must, of course, be taken in all the rooms likely to be affected if it is suspected that the chimney serves a divided flue. Buckets of water will be found more effective and simpler to use than a hand pump, owing to the difficulty of working on the confined space of a chimney stack, but if a hose reel is available this is usually the best method to use. If buckets of water or a hand pump are employed it is seldom necessary to carry water up through the house from the street, and this should be avoided, if possible, since spilling on the stairs is inevitable. A lavatory basin or tap is usually installed somewhere on the upper floors, or, failing this, water might be taken from the domestic cistern. If a bucket is being used it is a good plan, after the water has been emptied down the chimney, to turn the bucket upside down and put it on top of the chimney, thus confining the steam to the chimney and helping to extinguish the fire.

When putting water into a flue by either of these methods, care should be taken not to lean over the chimney, since the sudden generation of steam and possible blow-back when the water reaches the fire may cause serious injury. Close co-operation between the men working in the room and those on the roof is necessary to minimise water damage, and the man below should give the order "*Knock off*" immediately water is seen to be issuing from the grate, since this is usually a sign that a fire is extinguished. Communication is assisted if a man is stationed at an intermediate point on the staircase in order to relay the messages.

When tackling a chimney from the roof the following points should be noted :—

(i) Chimney stacks are often difficult to get at and, unless access can be simply and safely achieved by the stairway and a trap-door or skylight, there should be no hesitation in ordering on an escape or turntable ladder—it is far better to turn out an appliance than to endanger a man's life by making it necessary for him to work in a difficult and dangerous position. In some cases it will be found that the chimney is virtually unreachable except with the assistance of a turntable ladder. If either an escape or a turntable ladder is used, the fire can be tackled quickly and simply by taking the hose reel tubing up the ladder.

(ii) The brickwork of chimney stacks is often faulty, owing to old age and defective repairs, and should not be relied upon to give a firm hold unless it has been carefully examined to ensure that the mortar is in place and in good condition. The brickwork of a chimney stack should never be relied upon to give a hand-hold when climbing up on to the stack. The brickwork at the base, in the ridge of the roof, is more solidly constructed and should invariably be used.

(iii) Chimney pots crack very easily with heat, and care should be taken not to handle them or to allow water to fall on to them. Pots have been known to break up with an almost explosive effect

on the application of water and cause serious injury to men on the roof. If a chimney pot is at all suspect it should be removed and if necessary lowered (not thrown) to the ground.

(iv) When water is being used on a roof, care should be taken to see that quantities are not splashed about, that as little water as possible is used and that it is not allowed to fall where it can penetrate the roof, lest it should reach a room below and cause unnecessary damage and inconvenience to occupants, particularly if, as is often the case, the house is divided into flats and the occupier of the top flat was not responsible for the chimney fire. Buckets should therefore not be filled too full and should be passed up by a human chain and not carried by men scrambling over the roof. Care should also be taken not to damage slates or tiles while working on the roof.

(c) *Attacking at Different Levels.* In houses which have a roof void, an inspection door is sometimes fitted in the chimney breast, which can be reached from the roof void, and, if the roof is difficult of access, it may be advisable to tackle the fire through this door. If this is done, care should be taken to avoid water damage to the ceiling below. Inspection doors are also sometimes fitted at various levels in the flues above the grates (these doors will often be found covered by wallpaper), and if the fire has been particularly fierce and heat is still apparent after water has been applied from above or below, it may be advisable to open these doors and introduce a hand pump or hose reel nozzle to cool the chimney down. If inspection doors are not fitted, it may occasionally be necessary to remove a brick or two at the hottest point for the same purpose.

Again, during the preliminary inspection of the chimney, it may be found that the greatest heat is concentrated at one point, and in this case, if an inspection door is fitted near-by, it is obviously advisable to attack the fire first through this, as in many cases it may be possible to extinguish the fire effectively by this means. In general, however, attack from inspection doors will only be necessary in long or involved chimneys when the seat of the fire is difficult both to locate and attack.

(d) *Letting the Fire Burn Out.* If a fire has occurred in a straightforward flue which is of modern construction and in good condition, it may sometimes be advisable to let it burn itself out, and the desirability of doing this should not be overlooked. The Fire Service should, of course, remain on the premises until the fire is out, and the necessary equipment should be held in readiness in case a more serious fire develops.

(e) *General.* Particular care should be taken when dealing with chimney fires to ensure that the fire is extinguished. Examples have occurred of such a fire breaking out again several hours after the Fire Service has left, and, if there is any doubt, a man should be left behind to ensure the safety of the building. The occupier should in all cases be advised that if the flue shows any signs of heat after sufficient time has elapsed for it to cool, the Fire Service should again be notified.

When it is believed that the fire has been extinguished, the rooms

on every floor should be examined for hot walls or ceilings, and if the flue is located on a party wall, an inspection of the adjoining premises should also be made. Ceilings should be carefully examined for discoloration due to hidden fire. It is not unknown for sparks to ignite the soot which sometimes collects in the space between ceiling and floor above as a result of a defective flue. An accumulation of soot is also sometimes found in roof voids as a result of defects in the chimney breast (Fig. 24), and the ceilings of upper floors should be examined for discoloration or signs of heat.



Fig. 24. Working in a roof void. Note how man is standing on joists and has placed a bucket on a board to prevent it resting on the laths. The way in which a displaced brick can allow smoke to escape and soot to collect in the roof void is clearly shown.

When it is certain that the fire has been extinguished, every effort should be made to leave the premises clean and tidy. The affected rooms should be cleared up, any water or soot on the floor swept up and removed, and carpets and furniture replaced. If the room is too damp for this to be done immediately, anything which has been removed should be left neatly stacked in a corner of the room.

Before the firemen leave the premises, the occupiers should be advised not to leave the room empty for some hours on account of the danger from particles of burning soot, which may fall into the room and cause a fresh fire, if not immediately stamped out. Occupiers will usually ask whether a fire may be relit in the grate. If the fire in the chimney has been properly extinguished there should be no danger, but unless the fire is urgently required (for cooking, for example) it is best to recommend that the chimney be left to cool for two or three hours.

3. HEARTH FIRES

Defective hearths and fireplaces are a fruitful source of fires, especially in old houses. The correct construction of hearths and chimney breasts has already been dealt with in the Chapter on "Building Construction." In old houses, however, trimmer joists were often not used, the flooring joists projecting into the brickwork of the chimney, or being laid immediately below the hearth. In the former case the breaking away of the pargetting in the chimney

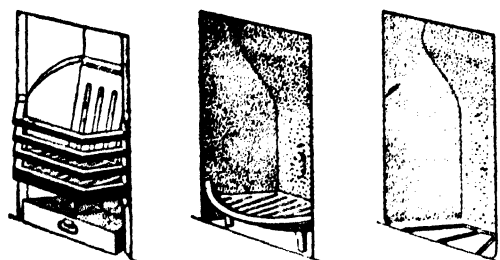


Fig. 25. Various types of grate. Left : Victorian type with ash pan which screens the hearth from the full heat of the fire. Centre : semi-well type. Right : well type in which the hearth is exposed to the full effects of the fire.

may expose the ends of the joists, which will then smoulder and char, and, if sufficient oxygen can reach them, burst into flame. The thin layer of hearthstone was reasonably safe with the Victorian type of fireplace (Fig. 25 *left*), where the fire itself was some distance above the hearth. In houses which have been

reconstructed and the fireplaces modernised, however, well-type grates (Fig. 25 *centre and right*) are often installed without suitable precautions being taken to insulate the joists below from the heat of the fire (Fig. 26 *left*), so that the fire is in close proximity to the joists, and as a result it is only a matter of time before they catch fire, and the fire spreads below the floorboards.

Good firemanship can be better demonstrated to the public when dealing with hearth fires than at any other time, since the difference between a neat and workmanlike cutting away (together with the careful removal of all debris) and the mess which results from a carelessly tackled job, is immediately apparent, even to the most inexperienced eye. A difficult hearth fire, if properly handled, should result in little more damage to property than that caused by the fire itself. It should be remembered that such a fire may have been smouldering for a considerable time (sometimes even weeks), and in such cases the few extra minutes required for thought and organising the arrangements will not be wasted. Operations should, therefore, be carefully planned before work is commenced, and the whole job carried out with care and deliberation.

(a) *Locating the Affected Hearth.* Smoke from a hearth fire may sometimes travel for considerable distances and not infrequently may emerge near another hearth which is not affected by the fire, and the fireman must therefore make certain that the correct hearth has been found before attempting any cutting away. A hearth fire can usually be recognised immediately by its characteristic smell, and the affected hearth can often be identified by this means alone. It should not be assumed, however, that

the fire is necessarily in the room (or even in the house) in which the greatest volume of smoke is found. Cases have occurred in which smoke from a hearth fire has first been noticed several houses away from that containing the actual fire, and there are many examples on record of hearths having been opened up in error when the fire was actually in the adjoining house, particularly when fireplaces back on to each other, as is common in semi-detached property.

If the seat of the fire is not immediately apparent, therefore, a careful search must be carried out. Enquiry should first be made from the occupier. There may have been only one fire alight in the house for many weeks (though this may not always prove an infallible guide) or a new grate may recently have been installed. In some cases it may be found that a basket fire has recently been removed and the fire lit on the hearth itself. If so, this will in most cases prove to be the one involved.

If preliminary enquiries reveal no helpful clues, all suspected hearths should be examined for signs of heat, cracking or the presence of smoke, and ceilings for signs of heat or discoloration, since a hearth fire often reveals its presence on the ceiling below. Once suspicion is concentrated on a particular hearth, the fire in the fireplace should be extinguished and the grate removed. The centre of the hearth beneath the fire should then be inspected for cracking, since this is usually the point at which a fire starts, and consequently the centre of greatest heat. The correct hearth can usually be ascertained by this means.

(b) *Preliminaries.* Before any attempt is made to attack the fire every precaution should be taken against unnecessary damage to property. Rugs, carpets, etc., in the affected room should be rolled back and any furniture pushed away to the far side of the room and sheeted up. Similar precautions should be taken in the room below. Receptacles such as a dustbin or buckets should be provided for the considerable quantity of debris which will result, and the necessary equipment should be obtained and laid out in readiness. This will include saws, chisels, a light sledge hammer, mallet, heavy crowbar and also some means for extinguishing the fire.

It should be emphasised that the principal difficulty with hearth fires is in getting at the burning material, and that, once this is exposed, the actual extinguishing is usually a simple matter, and little water will be required. In most cases a bucket or two will suffice; it should be applied either with a swab or a cup, rather than a jet, in order to avoid unnecessary damage to the ceiling below. Soda acid extinguishers are unsuitable for this type of work, since, once the discharge is initiated, it cannot be controlled, and water is normally only required in small quantities and at intermittent intervals. A spare bucket of clean water should also be available, to be used for settling the dust in the hearth at frequent intervals throughout the operations.

Finally, before operations are commenced, a man should be stationed in the room below to deal with any outbreak of fire which may be caused by the ceiling below the affected hearth giving way and allowing embers to drop into the room.

(c) *Attacking the Fire.* When everything is in readiness the first thing is to decide whether or not the hearthstone can be removed intact.

(i) *Removing the Hearthstone.* To remove the hearthstone, the battens round the stone or tiles should first be stripped away, and the manner in which the hearth is laid should be examined. There is an increasing tendency to run gas pipes and electric cables close to a hearth (in order to supply portable gas or electric fires), and the possible presence of these below the floor boards must not be overlooked. With certain types of hearth it may be possible to remove the stone in one piece by levering it up gently with a crowbar and rocking it from side to side until it is sufficiently loosened for it to be lifted up, when it should be taken outside.

If it cannot be removed in this way, it will have to be broken up, and in this case the first attack should be made in the centre of the fireplace, since this is the most likely place for the seat of the fire. A simple hearth fire can sometimes be extinguished by

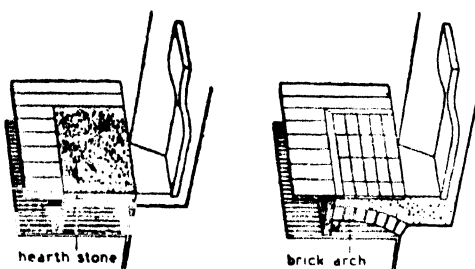


Fig. 26. Left : Incorrect type of hearth construction liable to lead to fires. The thin slab of concrete below the hearthstone is laid direct on to tongued and grooved boarding. The construction of this type of hearth can be seen in plan in Fig. 27 (centre). Right : well constructed hearth showing trimmer arch and concrete carrying tiled hearth.

cutting a neat hole about a foot square in this position, but if, after the fire is extinguished, any of the surrounding timber is seen to be charred, it is advisable to have the whole hearth up in order to make certain that there is no danger of subsequent re-ignition. In this case the stone should be broken up carefully and methodically and removed to the outer

air piece by piece, all dust and debris being swept up as the operation proceeds and water being used at frequent intervals to lay the dust.

If a tiled hearth is fitted, operations should not begin at the back, since any such breaking up will inevitably crack the tiles. They should therefore be removed whole. Tiles are not infrequently of special design and therefore difficult to replace, and care should be taken not to break them. If the job is tackled methodically, it should not be necessary to break more than the first tile to be removed. Hearth tiles are generally laid on a thin layer of plaster of paris and held in place by a wooden fillet. This should first be removed, and when once the first tile (preferably in a corner) has been taken out, the others can be prised up without difficulty with a chisel. The tiles should be carefully stacked as they are removed in order to prevent them being broken by anyone treading, or dropping a heavy tool, upon them.

(ii) *Cutting Away.* When the hearthstone or tiles have been removed, the construction of the hearth will be revealed. If it is well constructed there should be a bed of concrete several inches thick resting either upon a brick trimmer arch (Fig. 26, *right*, and Fig. 27, *below*) or upon tongued and grooved boarding, but with old hearths it will often be found that the stone is laid direct upon the tongued and grooved boarding (Fig. 26, *left*, and Fig. 27, *above and centre*). In each case, breaking up or cutting away should be continued until all the smouldering woodwork is exposed, when it should be extinguished with the minimum use of water. All surrounding woodwork should then be carefully examined for signs of charring and any affected portions removed.

Cutting away should be continued until it is certain that no charred or weakened portions remain. If there is any doubt about a particular section, a clean saw cut should be made so that the heart of the timber can be examined. As a general rule, it is better to take out too much rather than too little, since this will ensure that the builder makes a proper job when rebuilding the hearth, and does not simply scarf or otherwise patch up defective timber; but care should be taken not to cut into any timber or stonework which may affect the structure of the building. In some fireplaces, for example, a stone wall-plate may be found tied into the party wall, and this should not be damaged, as otherwise parts of the wall may have to be rebuilt. Similarly, joists should not be cut unless absolutely necessary, as such cutting away will weaken

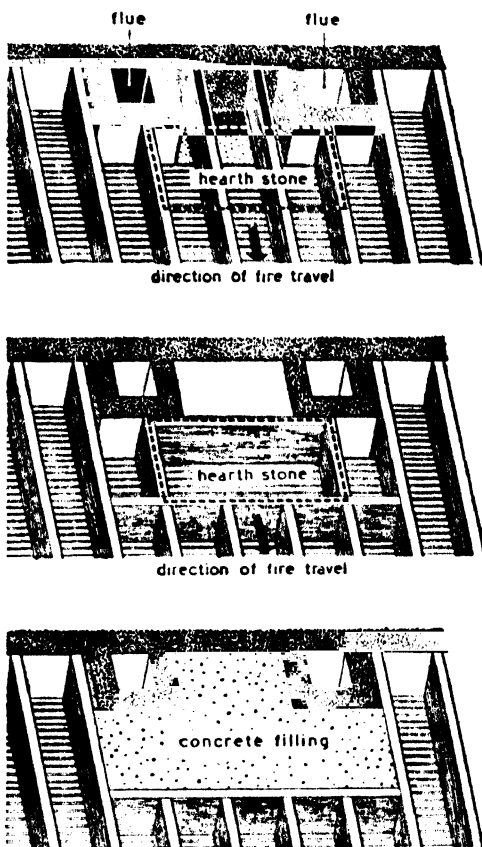


Fig. 27. Above and centre: methods of laying hearthstone on the joists which are first covered with tongued and grooved boarding. Below: construction with a trimmer arch.

the floor and possibly bring it down. Particular care should be taken when dealing with fireplaces which are set back to back in a party wall. In such cases it may be necessary to remove both hearths to make certain that the fire is extinguished.

(iii) *Removing the Surround.* It will sometimes be found that, even though the hearth has been removed, it is still impossible to reach all the affected woodwork, and it may then become necessary to remove the entire fireplace. The construction of these differs

considerably. The most common form of construction is shown in Fig. 28.

The general rule should be to work from the top downwards, i.e., the first step should be to remove the mantelpiece, then the frieze or lintel, and finally the vertical side members. These are usually secured to the wall by some simple fastener, such as an ear plate, a rag bolt or some other form of metal clasp, which can easily be detected by running the blade of an axe down behind the surround. In some cases the mantelpiece and the side members are made up in one piece and can be removed intact.

Marble and other stone mantelpieces are sometimes laid separately on brackets secured to the lintel and may be set into the brickwork.

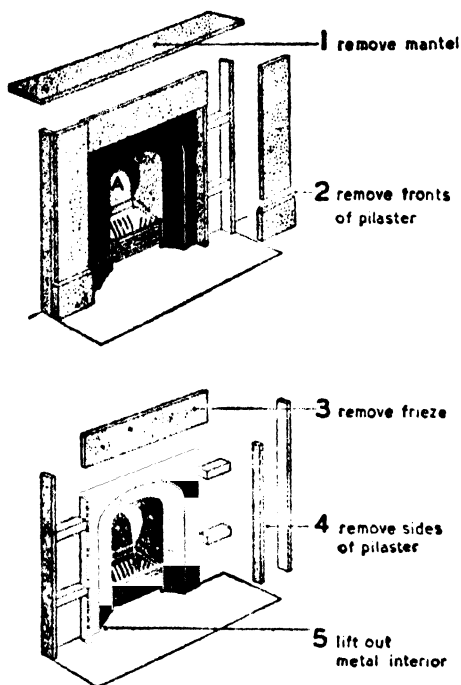


Fig. 28. Sketch showing the various stages in removing a mantelpiece and surround to free the grate. Note the register plate "A."

It should seldom be necessary, however, to break up a mantel or surround to remove it, since careful investigation will immediately reveal the method of fastening, and this can usually be released as easily as it was installed. When the entire surround has been removed, the fireplace will be exposed and can be taken out, thus revealing all the woodwork. Cutting away should then be proceeded with as before until it is certain that the fire is extinguished.

(iv) *Attacking from Below.* It may very occasionally be desirable to tackle a hearth fire from below, but there are many disadvantages to this method:—

(i) It is difficult to make certain from below that all the affected woodwork has been removed.

(ii) It is uncomfortable and dangerous to work in this position, since not only will hot embers and sparks fall into the fireman's eyes, but there is a serious danger that the entire hearth may fall. If it is apparent from the discoloration of the ceiling that considerable burning has taken place, it is advisable to shore up the ceiling under the hearth before commencing work.

(iii) Since the woodwork supporting the hearthstone will have been weakened by the fire, it may give way, if persons walk upon it or go near it after the Fire Service has left, and fall into the room below and injure persons there.

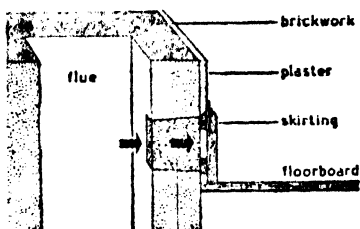
(iv) The hearthstone will in any case have to come up for the necessary repairs to be effected, and a double expense will, therefore, have been caused, since the ceiling will also have to be repaired. This method should, therefore, only be employed in very exceptional circumstances.

(d) *Clearing Up.* When the fire is extinguished any remaining debris should be cleared up and removed and the room carefully swept. A little extra help in replacing furniture and tidying up generally is always greatly appreciated by the occupier. Finally, before the Fire Service leaves the premises, the occupiers should be contacted and the supposed cause of the fire carefully explained to them, so that they clearly understand the need for having a properly constructed hearth installed when the repairs are done.

4. FIRES IN SKIRTINGS, ETC.

Fires sometimes occur in skirting boards near the hearth through incorrect methods of building, usually through the heat in the flue igniting the timber plugs used to hold the skirting in position (Fig. 29). This is very liable to occur when the inside lining of the chimney falls away, if the plug has been driven in too far. An example of a small fire through this cause is shown in Plate 19.

Examples are by no means infrequent of woodwork in close proximity to flues. Any fault in the lining of the flue, or in the mortar, allows the heat to reach the woodwork, and in time to ignite it. In Plates 20 and 21 are shown examples of fires which have resulted from this cause.



fire travels through wooden plug to skirting

Fig. 29. Poor building construction which allows heat from chimney to ignite the wooden plug which in turn transmits fire to the skirting board.

5. FIRES IN FUME DUCTS

Restaurant kitchens, fish-frying shops, etc., often have ventilating shafts with large sheet iron hoods over cooking stoves for the purpose of allowing the fumes from cooking to escape (Plate 22).

These shafts are usually made of sheet iron (Plate 23), but are sometimes of brick and may be of considerable size. They are not infrequently constructed with a total disregard for fire protection, passing through wood floors and in proximity to lath and plaster partitions, and either continue through the whole height of the building to the roof or to some convenient external ventilator, or else run into brick flues. Owing to the draught caused by the heat of the kitchen stoves, fine particles of grease are drawn up and are deposited along the sides. Inspection covers are often fitted at intervals, but this is by no means always the case and, frequently, no attempt is made to clean the ducts, so that a considerable quantity of inflammable material may accumulate after some years' use. If a spark should escape from the fire and pass up the shaft, or a pan of fat suddenly flare up, this deposit may sometimes be set alight, and will then burn with great intensity on account of the considerable draught.

Fires in these ducts must always be considered as potentially serious owing to the possible spread up the building, and the prime necessity is to inspect woodwork adjacent to the flue on every floor and at roof level, at frequent intervals, in order to make sure that this is not occurring. If the flues are above coal-fired ranges, and provided that for any reason cooking must not be interrupted, it may be possible, if the fire is relatively small, to extinguish it by splashing the fire with water to generate steam which, combined with subsequently shutting off the bottom of the flue, will prove effective. If a mechanical extractor system is fitted, this should be immediately shut down.

Such a fire can sometimes be extinguished by chemical extinguishers, hand pumps or hose reel equipment, but in certain cases it may be necessary to get one or more branches to work. If no openings are provided in the shaft, they must be cut in order that the whole of the interior can be inspected and the burning surface if necessary subdued. In this case if the duct is rectangular and of sheet metal, the cut should be made on the corner; this will ensure that all parts of the interior can be reached with the jet.

As these shafts so often take a tortuous course through the building (Plate 24), it is not sufficient merely to direct a branch or jet from either end, as this would only extinguish part of the burning sides—parts of the shaft must be cut away every 10 ft. or so in order to attack the fire at as many points as possible, otherwise there is always a risk of re-ignition. After a serious fire in such a duct it is normally wise to leave a man behind for as long as necessary to make sure that the fire has been extinguished and will not break out again.

6. ROOF FIRES

Roof fires present a number of different hazards, since the construction of roofs varies greatly, and access to the fire is often difficult. The general principle is that roof fires should always be attacked from inside, for, owing to the construction of all roofs, water applied to the outside will in general run away without doing

any good. It may, however, be helpful to separate these fires under the following principal headings :—

- (a) small dwelling-houses, cottages, etc., which, when in terrace, often have a common roof void ;
- (b) public buildings and large houses, such as country mansions, with the roof spaces over wings leading off a common roof void ;
- (c) industrial buildings having special types of roof, such as sawtooth roofs, Belfast roofs, diamond grid roofs, etc. ;
- (d) churches, theatres, cinemas, etc., in which the roof is high above ground level and often has a large roof void.

(a) *Small Dwelling-houses, etc.* In small terraced houses the roof void is sometimes continuous throughout the terrace, and a fire, unless it is correctly handled, may therefore spread rapidly throughout the length of the terrace. To reach the fire, access to the roof should be gained through the trap-door, if fitted, or if there is no such opening, part of the ceiling should be cut away, or entry gained by removing part of the roof cover. The place where it is proposed to enter should be carefully surveyed, so that, once access is obtained, the fire can be tackled in such a way that it will not be driven before the water into unaffected parts of the roof space.

Other things being equal, when entering the roof void from inside, it is preferable to cut away the ceiling on the landing at the head of the stairs, as there will then be a much smaller area to make good and repairs will not be so obvious as in a large expanse of ceiling in a room.

(b) *Public Buildings and Large Houses, etc.* There will usually be means of access to the roof space in buildings of this type, but if for any reason entry cannot be gained the fireman should consider whether it would not be preferable to go through the roof rather than cut away part of a ceiling, since ceilings in such houses may be of considerable value on account of their decoration or moulded construction. On the other hand, entry by opening up the roof may vent the fire, and thus make it more difficult to extinguish. Steps should first be taken to ensure that water is available to deal with any resultant increase in the fire.

(c) *Industrial Buildings.* Roof construction in such buildings varies so widely that it is almost impossible to lay down any general rules. Sometimes sawtooth factory roofs are constructed with an inner lining of inflammable building board, or, alternatively, the roof may be made up of bituminised materials along which fire can spread with considerable rapidity. In such a case, the only effective course to check the spread is to pull away portions of the inflammable material to form a break and then to station branches in strategic positions to cover it. Roofs are often lined with match boarding. This can easily be removed if it is remembered that it is usually secured very lightly to the joists and can be freed by tapping it lightly with the head of a large axe near the joists.

(d) *Churches, Theatres, Cinemas, etc.* Roof fires in churches, etc., are often the most difficult of all to deal with, owing to the height above ground level and to difficulties of access. In such a case the

fire can only be dealt with by positioning branches as close to the burning portion as possible, and using large nozzles with relatively high pump pressure to obtain the maximum vertical throw of water. Access to the roof is, however, sometimes possible *via* an internal stairway, particularly in cathedrals, and the verger should be contacted and asked to provide a guide.

Roofs of cinemas, on the other hand, although often having a large roof void, can usually readily be entered by means of special doors, etc., but since much of the ventilating trunking is carried in the roof, this may tend to spread fire considerably and make it difficult to reach certain parts with fire streams.

(e) *General.* The following practical hints for dealing with roof fires may be noted :—

(i) Roof fires frequently appear considerably more serious than they actually are, and large quantities of smoke are often emitted even when the fire is confined to birds' nests or small quantities of soot.

(ii) If a fire is through the roof, the use of a turntable ladder monitor in the initial stages will be most efficacious in preventing spread to other buildings, and to a certain degree in extinguishing the fire. Water damage on lower floors must be guarded against.

(iii) Turn-table ladder monitors directed from above tend to drive the fire laterally and make it harder to extinguish. It should be emphasised that it is imperative to attack a roof fire from inside if this is at all possible, and branches should be got to work inside the roof at the earliest possible moment. Once firemen have worked their way up to within reach of the fire from inside the building they can do more good, since they can strike the burning beams and rafters which are still screened by the roof coverings from water applied from outside.

(iv) When a roof is opened up ahead of a fire to form a break, sufficient distance from the fire must be allowed to ensure that the break can be completed before the fire reaches it.

(v) Very exceptionally, when the roof void is completely inaccessible, it may be advisable to let a fire burn through the roof, so that it can vent itself and can be tackled from each side. If it is confined it may tend to travel laterally in other directions.

(vi) Roofs are sometimes found constructed of corrugated iron with bitumen on both sides, and in such cases it is necessary to use water on each side.

(vii) Care must be taken to see that fire does not travel undetected beneath lead or zinc valleys or similar hidden spots. For this reason roof fires should not be left too quickly. It should also be remembered that in roof voids there is often an accumulation of dry dust which will aid the spread of the fire.

(viii) When it is necessary to attack the fire by removing roof coverings, this should be done from a part of the roof that will allow the jet to reach the whole of the interior.

(ix) It is usually wise to station a man outside the premises to warn passers-by of the danger of falling slates, tiles, etc.

(x) Since a roof fire occurs at the top of a building, the possibility

of damage to the contents by water is at its greatest, and the need for initiating salvage operations at the earliest possible moment should therefore be remembered.

(xi) Unless a very considerable throw is essential, jets inside the roof void should be kept working at a relatively low pressure, otherwise slates and tiles may be displaced by the impact of the fire stream.

(xii) For fires in thatched roofs see the Chapter on "Fires in Rural Areas."

7. ONE ROOM FIRES

A hose reel should usually be adequate to tackle a fire in a single room, and the fire should be attacked through the doorway, as this will prevent the fire spreading to other parts of the premises. The door into the room will very often be found shut, and care must be taken, before opening up, that equipment is in position and water available. A severe fire even in one room will normally be immediately visible from the outside. If the smoke is thick the branchman should crawl along the landing with his head and face well down and, as soon as the door has been forced, direct his jet on to the ceiling and keep it moving, after which he can attack the main portion of the fire. When he has worked his way sufficiently into the room he should direct his jet behind, and on to anything previously obstructed by, the door until the whole of the burning material has been extinguished.

Immediately the fire has been extinguished, the water should be shut off and the room ventilated by opening windows. Whilst the fire is being tackled, other members of the crew should examine the rooms adjoining, and those above and below, for traces of fire.

Any pieces of upholstered furniture, bedding, etc., which have caught fire should be removed, where feasible, through the window, so that they can be extinguished outside without causing further damage. During the operations, except where it is necessary to inspect adjacent rooms, men should not be allowed to tramp through unaffected rooms carrying dirt about the premises and possibly causing damage to floor coverings.

CONTROL AT A FIRE

IN Chapter 32 was surveyed the knowledge required of the individual member of the crew of an appliance attending a fire call. In this chapter it is proposed to deal with the work of the officer in charge, and to indicate some of the more important of the many points to which attention should be paid when handling a fire situation. Procedure will vary to some extent, according to whether the officer is in charge of the first appliance attending, of all the appliances arriving as part of the first attendance, or whether he is the senior officer in charge of a large fire ; so that this chapter will deal with the subject as far as possible under those headings.

1. OFFICER IN CHARGE OF THE FIRST APPLIANCE ATTENDING

(a) *Before the Fire.* The better the knowledge an officer has of the ground covered by his station, the better he will be able to deal with fires occurring on it. The value of local knowledge has already been discussed in Chapter 32. If there are any unusual risks in his area, such as an oil installation, an aircraft factory, or a chemical works, he should, of course, have made every effort to familiarise himself with their lay-out and contents immediately on being appointed. In co-operation with the occupiers, exercises might with profit be held on the premises.

A well-trained crew will know their individual duties thoroughly, so that on arrival on the fireground it should only be necessary for the officer in charge to issue general orders. Men are trained on the drill ground to carry out a particular operation in a certain way, and should be able instinctively to adapt drill routine to the requirements of the particular situation.

(b) *On Arrival.* At the great majority of fires, the Fire Service officer will be confronted on arrival with a number of points which will require his immediate attention. These may be listed as ; appreciating the situation and deciding whether the equipment and appliances which he has or will shortly have are sufficient for the job ; effecting any necessary rescues and searching the building ; finding the fire and getting water on to it ; surrounding the fire to stop it spreading ; ventilating the fire where applicable ; and giving instructions for the carrying out of any necessary salvage operations.

The first step on arrival will be to enquire from the Police or from onlookers whether any persons are believed to be in the building. Information obtained in this way, however, should never be accepted without question, and a search of likely premises should always be made in order to verify that, in fact, no persons remain to be rescued (see Chapter 36).

(c) *General.* Whilst the general principles of handling a fire situation are much the same irrespective of the size of the building, there are considerable differences in detail in their application as

between small and large fires. It will therefore be convenient to deal first with certain of the more important points to watch when called to a small fire which, for this section, will be taken as a fire which can be dealt with by the first attendance. Subsequent sections will be devoted to the high degree of organisation and planning called for in handling a large outbreak.

Immediately it is known that the outbreak can safely be handled with the appliances available, the "stop" message should be sent back. This will indicate that no further mobilising arrangements are necessary except perhaps for sending reliefs, and will tell senior officers that the outbreak is under control and that their presence is not required. It need hardly be added that it indicates a serious lack of judgment or undue haste in appraising the situation if after the "stop" has been sent, further assistance has to be requested. If the facts required to enable the officer in charge to send back an informative message are obvious (*e.g.*, a room on fire in a private house or a car on fire in the road, etc.), then this can be included as part of the stop message. Where the detailed part of a stop message cannot immediately be framed, then the stop message should not be delayed, for a phrase such as "details follow" can, in such cases, be added. Notwithstanding the receipt of a stop message, a senior officer may be in doubt as to whether to go on to a fire, and the receipt of the details will then enable him to make up his mind, or alternatively, the information given may make him decide to go on when he would not otherwise have done so, *e.g.*, to a small fire where there has been loss of life.

Whilst water damage is at all times to be carefully avoided, this assumes particular importance in the case of small fires where even a relatively slight excess of water can cause damage out of all proportion to the size of the fire. When full sized hose lines are in use, hand-controlled or diffuser branches, which permit the water to be shut off as required, will reduce water damage. To obviate water damage from percolation, rubber-lined hose should be insisted on for all lengths inside the building.

2. OFFICER IN CHARGE OF FIRST ATTENDANCE APPLIANCES

Under normal conditions, one of the first attendance appliances will arrive slightly in advance of the others. The officers in charge of the later appliances to arrive will be guided in their actions by the position as it appears on arrival. If, for instance, there are obviously a number of urgent rescues to be effected, they would immediately get their crews to work without reference to the officer in charge of the first appliance, for he would be fully occupied. On the other hand, if the fire is a small one and they are not immediately required, or if the nature of the work to be undertaken is not readily obvious, then they would contact him first and ascertain what, if anything, is required of them.

Riding on one of these appliances there may be an officer senior in rank to the officer in charge of the first appliance to arrive, and he would take charge of operations until in turn he is relieved by an officer senior to him (see also p. 79). Whenever one officer

relieves another the remarks in Chapter 32, p. 9, about the necessity for there being a definite handing over of command at the fire should be borne in mind.

Where two officers of equal rank attend, the first on the fireground will retain control of the fire, although where one of them is on his own ground it is customary and preferable for him to have charge, because he will have the better local knowledge and because he will also have to prepare the report on the fire.

On the officer in charge devolves the responsibility of deciding whether or not the appliance or appliances which have already attended are sufficient for the purpose, or whether additional assistance is required. If there is any doubt as to whether the appliances attending are sufficient in number, no chances should be taken and assistance should be asked for.

(a) *Estimating Assistance.* To estimate whether additional help is required calls for rapid assessment of the position—generally known as “sizing up.” This sizing up must take account of the following principal factors:—

(i) How far the fire is likely to spread before a suitable cut-off can be established.

(ii) How many and what type of jets are likely to be required to subdue the outbreak, and consequently the number of pumps required to feed them.

(iii) Whether any special appliances are required, *e.g.*, escapes or turntable ladders for rescue purposes or to gain access to high windows; turntables for use as water towers; breathing apparatus or foam to deal with particular classes of fire, and so on.

(iv) The nature of the exposures surrounding the building and whether the outbreak seems likely to threaten them.

(v) Whether or not the water supplies available are handy and will prove adequate or whether a water relay will be required.

(vi) The nature of the goods stored or manufactured in the premises, and the influence the type of construction of the building will have on operations. The degree of inflammability of the contents and the construction of the building will give a good indication as to whether the outbreak is likely to develop fiercely and quickly or can be readily extinguished.

(vii) Whether it is a top storey job in a high building, for this may well require a far bigger attendance than one at a lower level. Far more hose will be necessary, it takes longer to get the hose into position and to get messages to and from the pumps. In such cases it may be wise to arrange for two crews to work as a unit. For top storey or roof fires it is usually wise to order on a turntable ladder, since water can be got on to the fire far more quickly with its aid. A turntable ladder will also often make it easier to get personnel rapidly into positions which would otherwise be difficult of access.

(viii) How far salvage work will be able to safeguard property. A fire in an upper floor often calls for a great deal of salvage work, so that the need for ordering on salvage tenders will also require to be remembered.

(ix) The greatest danger of fire spread in the initial stages is by way of internal areas, lift shafts and staircases (see Plates 1 to 4, and 9). The width of the street usually stops a fire from spreading at the front, and the party walls separating it from the adjoining buildings should check lateral spread, but the rear of a building is often vulnerable, so that the importance of providing adequate cover here must be kept carefully in mind.

Dwellings fronted by projecting shops sometimes present considerable rescue difficulties and may require the use of hook ladders and lines because the projecting part often makes it impossible to pitch an escape at the front windows (Fig. 1). In such circumstances a ladder must be raised to the roof of the projecting portion and pitched from there. Fire escapes and exits from this class of building frequently open out on to the roof of the main building, sometimes making rescue problems far from easy.

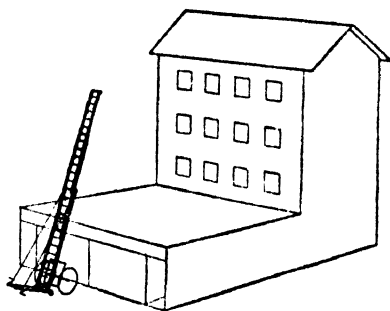


Fig. 1. Diagram showing that an escape cannot be pitched to the main building where there is a projecting shop.

If the Police are not in attendance on the fireground and are likely to be required, a message should be sent back to the mobilising control asking for their presence.

When a fire occurs in commercial or industrial premises during working hours, steps should be taken early in the operations to contact a responsible representative of the management. At night or when the premises are closed, this will not usually be possible, but the Police may sometimes be able to assist. The works manager, for instance, will have full information about the work carried out in the premises and the type of goods likely to be found and where; if they are of an unusual or hazardous type, he will probably be able to indicate whether any special precautions are necessary in tackling the fire. In certain cases the use of water may be inadvisable, and the works manager may be able to advise on alternative methods to be adopted. In certain circumstances it will be found that the fire protection officer will have a good knowledge of the premises and of the risks involved.

The works manager will be able to give information on the whereabouts of special stores, such as carbide, petrol, film, etc. He may also indicate whether or not certain parts of the premises are more important than others, *e.g.*, the drawing office or pattern shop may contain material which is virtually irreplaceable and, subject to other overriding considerations, the Fire Service officer would endeavour to concentrate attention on those parts of the premises which the management regard as specially important.

In addition to advice on the contents of the building, information

can also be obtained on its construction and on any features which might lead to unusual fire spread ; on whether or not there are heavy loads on any particular floor ; on alternative means of entry or exit ; on the position of internal protection equipment such as hydrants, risers and special types of extinguishers ; on the location of party walls or the whereabouts of fire-resisting doors and many other details which may materially assist the officer in charge in his attack on the fire. It is always extremely helpful to have available an employee of the firm who is well acquainted with the premises and who can act as a guide to officers on the fireground.

In some cases the occupier may, on the grounds of safety, advise against entry into the building. The officer in charge must then weigh up the position and decide whether to follow such advice. It sometimes occurs at a large fire that an official of the firm greatly exaggerates the possible dangers to be encountered. The officer in charge, therefore, must listen to all the information he is given, but if he is not absolutely satisfied that it is accurate, he must investigate for himself.

When computing the attendance required, it should be remembered that, within reason, too many appliances are far better than too few, for it is unforgivable to run risks with other people's property. If the requirements are understated in the early stages, there is a serious risk of the fire spreading and developing into a major outbreak when this could have been avoided. If too many appliances arrive, the surplus can always be returned to their stations. On the other hand the officer in charge should not get nervous every time he sees an unusually large burst of smoke or flame and order on additional appliances when those for which he has asked have not yet arrived. When framing a request for the attendance of special appliances, particularly in the less densely inhabited localities, consideration should be given to the distance they will have to travel. It is useless to ask for an appliance if it will take so long to arrive that all need for it will almost certainly have passed by the time it reaches the fireground.

Before a request for assistance can be made, therefore, the officer must have considered these various factors and decided on a plan of campaign for attacking the fire, but it will be realised that the appreciation of the situation will be made almost automatically and in a matter of moments. The trained fireman, on drawing up at a fire, will in most cases grasp the situation, and perhaps from the size of the building alone will see whether the job is one which can be handled by the first attendance appliances or, if not, will be able to send back an assistance message which can subsequently be varied if further investigation shows this to be necessary.

A further point to bear in mind is that it may not always be desirable for assisting appliances all to report to one place, on account of the congestion which they would cause and because, in any event, they would have to go on to other parts of the fireground. Instructions should, in such circumstances, be given that appliances should report to a specified officer at a specified place, which must be clearly identified in the message. The officer to whom they will report will,

of course, have made his plans as to how the appliances which arrive are to be disposed, and will be on the lookout for them.

If, under the arrangements in force locally, an ambulance does not attend every fire call then, if persons are believed to be in the building, it is always a wise precaution to order an ambulance in case medical attention is necessary. This will ensure that any persons who may be rescued from the building can, if necessary, be removed to hospital without delay. It is also an advantage to have an ambulance on the fireground when a considerable number of men are at work, since there are often minor injuries which can then receive immediate attention.

(b) Messages. The various methods available for despatching messages are dealt with in the Chapter on "Communications," and examples of appropriate messages will be found in the N.F.S. Drill Book.

When an assistance message is sent back it should either be written out or sent verbally by a man who can be trusted. The sender should make sure that it is in the correct standard form. This will ensure, first that a messenger who has been trained in standard messages will have no difficulty in remembering it, if it is to be delivered verbally, and, second, that the message will be correctly interpreted by those receiving it, and the necessary steps which it involves will be taken without delay or confusion. A messenger who is sent with either a written or a verbal message should always report back to the sender that it has been safely and correctly delivered. The necessity for this was once emphasised at a serious fire when a messenger on his way to deliver an assistance message was injured, and the officer in charge was for some time unaware that the message had never been delivered. A copy of all messages passed through a control point (see later) should be retained. It is then possible to check what orders have previously been sent, the time of despatch and so on.

Messages have a twofold function, for not only do they serve to ask for assistance but they give senior officers at their headquarters some indication of the size and nature of the fire. Even if further assistance is not required, every effort should be made to get back, as early as practicable, an informative message which will serve to tell senior officers the nature of the fire and whether it has been surrounded. Occasionally it may be some time before the seat of the fire is located, and an interim message to that effect will inform them of the position and enable them to consider whether or not they wish to attend.

Fires in certain types of premises or involving certain commodities may provide features of unusual technical interest. If this can be indicated in an early message, valuable information may be obtained by the Honorary Fire Observers or by specialist officers (*e.g.*, a Fire Protection officer*) who can then attend.

(c) Getting to Work at the Rear of the Building. If, on arrival at a

* Often referred to hitherto as a "fire prevention" officer. "Fire protection" is the term now used in the National Fire Service.

fire, it is seen to be a rescue job, it is wise to send two men to the back of the building, if necessary through the adjoining premises, with a ladder and lines, thereby covering the rear of the premises for rescue purposes.

(d) *Getting Water on to the Fire.* Since the first consideration must always be to get water on to the fire, the first attendance appliance will, of course, set in to the nearest available effective water supply, whether hydrant or open water. The appliances which follow on can then be employed to supplement the water supplies if these are inadequate. At every rescue job it is essential to get water on to the fire at the earliest practicable moment, for the success of the operations will frequently depend on the promptitude with which this is done. Unless life could thereby be saved, a building should never be opened up until water is available and branches are in position to hold the violent increase in the fire which sometimes results from the inrush of air (see Chapter 37).

(e) *Shutting off Services.* Once entry has been made into a building, it will be necessary to decide whether or not it is advisable to shut off certain of the services.

(i) *Gas.* Gas should immediately be shut off at the control cock (see the Chapter on "Fires in Gas Undertakings,") except where the building is lit by gas and people are still present. Cutting off the light might lead to panic.

(ii) *Electricity.* This has been discussed in Chapter 32. In the case of fires involving electrical authority's equipment, a message should be despatched to the appropriate undertaking by the quickest practicable route asking for the current to be cut off. This will also be necessary where overhead wires (*e.g.*, tramway or trolley bus) interfere with the working of escapes or turntable ladders, even though the trolley bus shorting gear described in Part 1, p. 247 has been used.

(iii) *Sprinklers.* Whether or not a sprinkler system is installed will be known immediately on arrival (see p. 10), and a fireman should be stationed at the main stop valve with specific orders that it is only to be closed on the direct instructions of the officer in charge. Sprinklers will do much to hold a fire in check, or even extinguish it, and prematurely shutting off the water may well allow the fire to get out of hand (see the Chapter on "Sprinklers, etc.").

(iv) *Refrigeration.* When refrigeration is employed in the building, a decision will have to be made as to whether to shut this off, in whole or in part. On this, the manager of the premises will best be able to advise. Ammonia, sulphur dioxide, carbon dioxide and several organic compounds are used as refrigerants, and the escape of any of these will make conditions difficult, if not impossible, for the firemen. If, therefore, refrigerating plant is installed, breathing apparatus should always be immediately available.

When closing down refrigerating plant, it should be borne in mind that the goods protected are perishable and might well be spoiled through this cause. This action, therefore, should not be taken unless it is essential to the efficient conduct of firefighting

operations. In a large installation dangerous conditions may be set up by incorrect manipulation of the valves, and, if it is necessary to operate the plant controls, the engineer should be asked to carry out the adjustments. Under certain circumstances, the engineer may be able to arrange for the discharge of the refrigerant at a point clear of the firefighting operations (see the Chapter on "Special and Unusual Risks").

(v) *Ventilation Systems.* Certain buildings (see the Chapter on "Building Construction") are fitted with ventilating systems, and in a few instances the occupants may rely on them almost entirely to maintain a breathable atmosphere. Whether or not a ventilating system should be shut down or, if this is possible, operated in reverse, will depend very largely on its design and layout, the nature of the building and the type of fire. Part of the system only may require to be shut down; the maintenance engineer will know what degree of control over the plant is obtainable, and his advice should be sought.

When operations permit, attention should also be given to any buildings adjacent to that on fire which may be fitted with a mechanical ventilating system. Cases have been known where such a system has drawn in smoke from a neighbouring building on fire, resulting in a false alarm with serious consequences.

(f) *Positioning of Branches.* The type of extinguishing medium which should be used in any particular case has already been discussed in Chapter 32, so that this section will be limited to dealing with the positioning and control of branches.

Whenever possible, fires should be fought from inside the building. This course may not be so spectacular and may sometimes be the subject of uninformed criticism from onlookers, who may think that nothing is being done. It need hardly be added that this possibility should not be taken into account. It may not be practicable to get into a building in the early stages of a fierce quick fire, but an effort should be made to enter at the earliest possible moment.

The first consideration is to get the fire surrounded so that it cannot spread. This will normally involve getting two or more branches to work, but it will sometimes be advisable, as a precautionary measure only, to arrange for one or more lines of uncharged hose, or even charged hose, to be laid without necessarily getting to work. The simplest example of the principle of surrounding a fire is shown in Fig. 2, in which a long shed is on fire about the middle. If the influence of the wind is discounted, then the first branch would be got to work as shown, to stop the fire spreading one way down the shed, the second branch would be sited on the other flank to prevent spread in that direction, and, if necessary, a third would then be used to work into the seat of the fire. On this

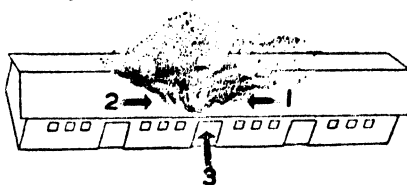


Fig. 2. Diagram showing how necessary it is to prevent a fire spreading to the flanks before attacking the heart.

plan there is no danger of uncontrolled spread, as would be the case if the first branch were got to work on the seat of the fire, thus allowing it to spread to either flank. In deciding on the number, size and position of jets, account must always be taken of the necessity for reaching the heart of the fire and applying the water to the material which is actually burning.

A sure way to stop a fire crossing the street and entering windows on the opposite side is to place men with branches at certain of those windows. If the fire is likely to "jump" the street, any exposed windows may be covered as a temporary measure by street branches or those from turntable ladders.

Outside branches, whether from turntable ladder or street, are often a severe handicap to those working inside the building; they tend to force the fire into the building and on to the staircase and landings and make working conditions inside very difficult. They must therefore be shut down at the first possible moment, and firefighting left to the crews inside.

Sometimes, in top storey jobs, the staircase will be found to be burnt away. In such a case, outside branches will have to be kept at work whilst escapes or ladders are being pitched or an improvised internal staircase of scaling or extension ladders is being constructed.

The officer in charge of an inside branch should never hesitate to knock off an outside branch or jet from a turntable ladder if it will facilitate operations and result in speedier fire extinction from within. He may be able to communicate from a window or from the roof with the man at the head of the ladder, whose training will enable him to appreciate the position and cause him to ask for his jet to be shut down.

(g) *Influence of Wind.* Whilst, in fires which are confined, the wind direction will not be of great consequence, it may become an important factor in fires in the open, e.g., in timber yards, open sheds,

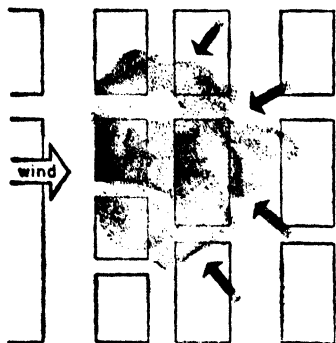


Fig. 3. Diagram showing the possible location of branches used to check the spread of fire when wind is an important factor, e.g., at a fire in a timber yard.

etc. Under such conditions, the first branches should be so placed as to prevent the fire driving to leeward and spreading before assistance can be obtained. In spite of heat and smoke, therefore, branches must be located in the probable path and on the flanks of the fire, so as to cool down any adjacent threatened property and prevent the fire travelling with the wind (Fig. 3). It is, however, a feature of all very large fires that the wind drives in from all sides on account of the uprush of the column of heated air immediately above the fire.

(h) *Preventing Fire Spread.* The various factors which lead to fire

spread have been dealt with in Chapter 32. It is, therefore, sufficient here to draw attention to those matters which require the immediate attention of the officer in charge. The probable location of party walls will have been noticed on arrival, and the position of these and other cut-offs which should assist in checking the spread of fire will be taken into consideration. It will be realised that in modern buildings with fire-resisting floors, horizontal fire travel is the more usual, whilst in older buildings the spread tends more in a vertical direction. When a party wall is being relied on to check the spread of fire, one or more crews must be detailed to patrol and inspect the adjoining compartment or premises to make sure that fire has not broken through by way of some constructional defect (see Plates 6 and 7 facing p. 28). In the case of a wall designed to prevent the spread of fire, crews should be detailed to work rapidly through the building seeing that all fire-resisting doors are closed, having first ensured that no one will thereby be cut off in the premises. Where unprotected openings occur in an otherwise good cut-off, a water curtain, using jets or diffuser branches, may prove effective.

Unless firefighting considerations require otherwise, doors in the building on fire should be kept closed. The normal $\frac{3}{4}$ -in. deal panel door is sufficient to hold back a relatively intense fire for several minutes, whilst doors of more solid construction will prove correspondingly more efficient. The closing of windows in buildings adjacent to, and threatened by, that on fire will reduce the possibility of fire spread due to brands entering rooms and igniting combustible materials.

Except in conditions of unusually high wind, a wide street or other open space should form an effective fire break; whilst in buildings, party walls, particularly where they extend above roof level, should prove effective. If they do not extend above the roof, however, there is a danger of fire spreading along the roof timbers. A close watch should be kept on the possibility of fire spread to lower floors through burning debris falling down lift shaft openings, light wells, etc.

A jet played vertically up a lift shaft may be a good temporary way of stopping a fire from jumping from floor to floor until branches can be got into position by way of the staircases. Once there is no danger of a fire in a lower floor spreading to those above, all windows and doors in the upper floors should be opened to release heat and smoke.

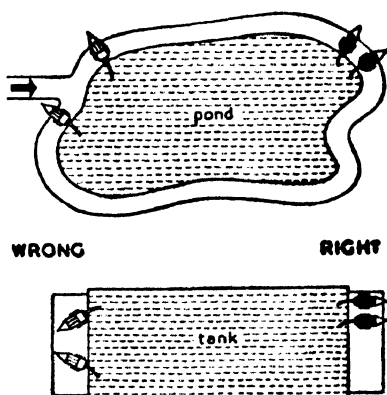


Fig. 4. Diagram showing how pumps incorrectly set in to a water supply can block the approach of other pumps which follow on later. Left: Incorrect methods. Right: correct methods.

(i) *Positioning Appliances and Equipment.* Crews in charge of pumps should set them in to hydrants or open water so as to cause the minimum of obstruction, and pumps setting in to open water should leave room for other pumps which may follow them to set in (Fig. 4). Care must also be taken not to obstruct the gateways to industrial premises in order to permit appliances to move in and out as necessary. If a pump must be kept at work outside a house for a considerable period, the occupants should be warned to shut doors and windows on that side and open those on the far side of the building. A case is on record of the exhaust fumes from a pump working under such conditions being drawn into a house and causing the deaths of two of the occupants who were asleep.

If a turntable ladder has been asked for, space in which it can get to work efficiently must be reserved for it to set in. Lines of hose should be run out ready to connect up to it immediately it arrives and, if the turntable ladder is not fitted with a pump, the desirability of providing a pump to feed the turntable ladder monitor only, should be kept in mind.

When setting a number of reinforcing appliances to work from hydrants, careful consideration should be given to the size of the mains and whether or not they are directly connected to other mains feeding adjoining hydrants which are also being tapped. The conditions under which collector working (see Part 3, p. 85) may be desirable, should also be kept in mind.

Care must be taken that appliances are not stationed where they can be endangered by falling walls, or in positions from which they could not readily be extricated should the fire spread unexpectedly.

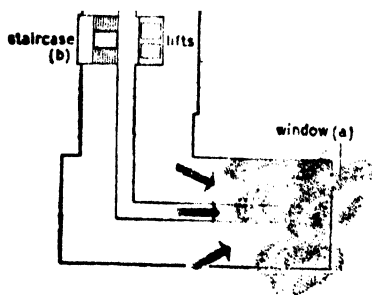


Fig. 5. Diagram showing the correct way of tackling a fire in the wing of a building with hose lines taken up the staircase.

(j) *Incorrect Handling leading to Fire Spread.* One cause of fire spread is failure to prevent the fire "driving before" the water. Thus, for example, in Fig. 5 a fire is illustrated on the upper floor of a large building which, it will be assumed, is showing at a window (a). Immediate steps should be taken to attack the fire by suitable equipment taken up the staircase (b), allowing the heat and smoke to escape through the window at (a). If a branch is got to work from a ladder pitched to the

window at (a), the fire may well be driven before the water and involve the whole floor.

Nowhere is this danger of driving a fire more obvious than in the case of projecting shops. The first appliances will almost invariably arrive at the front door and a branch will be got to work from the front of the premises. It can be seen from Fig. 6 that if the fire is driven before the water it will immediately be forced into the main

part of the building. As soon as practicable, therefore, men should be sent round the rear of the premises to get a branch to work to check the progress of the fire. Events which happen at the front of a building on fire are always obvious, those at the rear are less so and tend to be overlooked.



Fig. 6. Tackling a fire in a projecting shop. Left : showing how the fire can be "driven before" the water and involve the whole premises. Right : attacking from the rear and so preventing spread.

3. ARRIVAL OF A SENIOR OFFICER WITH CHANGE OF COMMAND

When an officer, senior in rank to that of the officer in charge, arrives on the fireground, he should contact the control point or the officer in charge, whichever he can do with least delay. If he, personally, does not go to the control, then he should send a messenger to notify the control of his presence on the fireground. He should, however, always endeavour to go to the control himself, for it is there that the fullest information concerning the fire is likely to be available. Points to which he will pay immediate attention are whether :—

- (i) a thorough search of the building has been made ;
- (ii) the fire is adequately surrounded ;
- (iii) sufficient pumps or special appliances are in attendance or have been ordered ;
- (iv) the necessary messages have been sent.

If he has satisfied himself that the situation is being adequately handled, it will often be best to allow the officer already in charge to carry on. If he decides to take charge, he must indicate clearly to his subordinate that he is doing so by some such phrase as "I am taking over," for it cannot be too strongly emphasised that a senior officer's mere presence on the fireground does not indicate his assumption of authority at the fire, although it must always be remembered that, if he is present on the fireground, the ultimate responsibility for the satisfactory conduct of operations must be borne by him. Senior officers will often wish to attend, primarily to see for themselves that the organisation which they have built up and for which they are held responsible is functioning efficiently, but before taking over they should consider carefully whether the size of the fire warrants their doing so, for it is disappointing to a junior, and damping to enthusiasm, if he feels that his senior will invariably take charge merely by virtue of his rank.

(a) *Use of Pump's Crews.* At large fires one or more crews should be kept fallen in, but standing easy, close to the advanced control point (see p. 83) for use in emergencies ; if, for instance, the fire should break out in some unexpected place or a wall collapse and men

have to be rescued they will then be immediately available. If any further appliances are in attendance but not at work, the officer in charge of each should stay at the control, the men remaining with their appliances. They are then immediately available to take orders from the officer in charge of the fire to get to work wherever necessary.

In order to minimise congestion and reduce the length of hose lines, the pumps closest to the fire should, as far as conditions permit, be used to their full capacity. When an additional line has to be laid, the officer in charge should consider (always provided the water supply is adequate) whether to connect up to a pump which is already in position and which has one or more deliveries spare. Branches can often be got to work more rapidly and a considerable economy secured in the amount of hose used. The pump operator, knowing the number of branches and the size of the nozzles in use, should be able to provide the necessary information as to whether this is possible.

(b) Large Jets. Anything but a large jet is useless in a situation where there is a large body of fire, and, under such circumstances, arrangements must be made at an early stage for replacing several smaller jets, such as 1-in. or 1½-in., by a single larger (1½-in.) one.

When ordering large diameter jets to get to work, careful consideration should be paid to the part of the premises they are going to strike. They may make it difficult, if not impossible, for men to work in some parts of the building, and may bring down walls, especially if these have been weakened by fire.

If the fire is likely to be of considerable duration, the best possible use should be made of branch holders, portable directors or ground monitors, in order to conserve manpower. Two men can look after several large streams if directors or monitors are used, and can alter the direction of the streams one at a time as required by the fire situation. This is of particular value in damping down operations.

(c) Use of Dams. At many large fires it may prove sound tactics to erect one or more dams close to the fire so that the suctions of a number of appliances feeding branches can be set into one such dam. The advantages are that relatively short hose lines to the branches can be used, thus reducing frictional loss, less hose is required and message carrying between branch and pump is considerably easier. The outstanding advantage, however, is that all the water is pooled and there is no risk of one pump having a surplus whilst its neighbour is short of water. Moreover, the water situation is at all times under immediate observation, and the officer in charge can readily see whether there is sufficient water for those already in use, or whether additional pumps or branches can be got to work. If suction crutches are available, then a "Sportapool" dam is satisfactory, otherwise a scaffolding dam is to be preferred.

(d) Ramping Arrangements. Every endeavour should be made to keep hose lines well into the side of the road. When hose is run across the road, it should cross at right angles to the flow of the traffic, so that the ramps are correctly set for the vehicles which

must use them (Fig. 7). Where it is obvious that several hose lines must cross a road on which traffic must continue to pass, a ramp lorry should be ordered and, if a considerable volume of traffic is passing, a man should be stationed at the more important crossings to warn approaching traffic and to rearrange displaced ramps without delay. At night he should, of course, be provided with a suitable lamp. A couple of ramps are quite inadequate for a busy crossing, and every endeavour should be made to form a continuous bridge. If unusually heavy traffic uses the road it may be possible to form an overhead bridge using extension ladders and lines. In this case adequate head room must be provided (see Fig. 8).

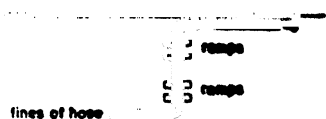


Fig. 7. Diagram showing how hose lines should be laid across a road to ensure that ramps are correctly placed to take traffic passing over them. Ramps are shown in simplified form only.

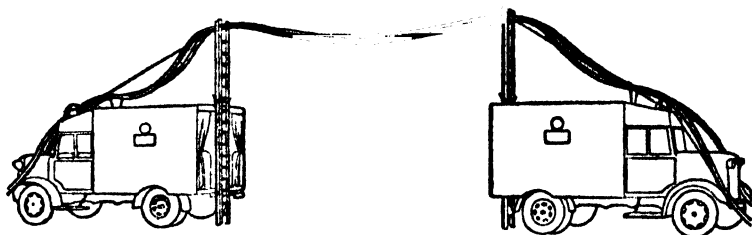


Fig. 8. Sketch showing a method of improvising a hose bridge across a busy street where ramps would cause a serious obstruction.

Where railway lines must be crossed, it will usually be possible to remove part of the ballast and pass the hose lines *beneath* the rails. If tramlines must be crossed, it may, in a few towns, be possible to arrange for the provision of tramway ramps (see Part 1, p. 99).

(e) *Use of Junior Officers.* In order to ensure adequate control of operations at a large fire, junior officers should be freely employed, both on specialised duties and to look after groups of branches, or to take charge of one or more sides of the fire. If poor jets, which are doing no useful work, are seen, such officers will ensure either that they are shut down to provide more water for better placed branches or that steps are taken to improve them. In particular, an officer should, in suitable cases, be detailed with the sole function of seeing that adequate water is available and that the pumps at work make the best use of supplies.

The officer in charge will often instruct a junior officer to take his place at the control point, whilst he himself enters the building or tours the fireground to see how operations are proceeding. Alternatively, he may find it desirable to employ one or two juniors to act as staff officers to tour the fireground and bring back reports from the officers in charge of various sides as to how operations are

proceeding. Officers giving orders at fires should keep in mind the possibility of conflicting orders being issued by other officers on the fireground, and should be careful to ensure that all orders are passed through the appropriate junior officers, who will then give them to the crews to whom they apply. Nothing is more irritating to men on the job than to have orders reversed needlessly.

Some of the ways in which junior officers can be employed are dealt with later under section (j).

(f) Dealing with Crowds. It will usually be found that the Police will provide, unasked, adequate assistance in dealing with crowds, but should this not be the case, no time should be lost in sending back a message asking for this assistance. Where sufficient Police are not available, it may be possible to rig up a long line to act as a barrier to keep the crowd at a reasonable distance. Apart from firemen and salvagemen no one should be allowed to enter premises which are on fire except with the express permission of the officer in charge. Obstruction of the Fire Service whilst at a fire is dealt with in Chapter 32, p. 49.

(g) Setting Up a Control Point. At every fire there should be some point where the officer in charge can be contacted, whilst at a large fire it is essential for the efficient control of operations for the officer in charge to have, close to the fireground, a temporary administrative headquarters.

At a fire requiring a first attendance only, contact with the officer in charge presents little difficulty, since the fireground is of limited size; the appliance or appliances outside the building will immediately indicate his approximate whereabouts. In the case of most fires of moderate size, however, the officer in charge should take steps as soon as possible to set up a control point in front of the fire. This point should be clearly indicated (see below) and should be set up clear of smoke and heat, where it can easily be seen and reached by officers in charge of appliances which subsequently arrive, and where it will be within convenient reach of officers supervising firefighting operations. Control points are normally set up in a Fire Service appliance—a control unit—but it may sometimes be possible to utilise a room in a suitably located building.

Good communications are essential, so that it is convenient if a control point can be located near a public telephone box, fire alarm fitted with telephone, or in premises where a telephone can be used. Alternatively, a mobile wireless transmitter/receiver may be stationed alongside and contact established with a mobilising control through the wireless system. In certain areas, field telephone lines may be of value in establishing communications. For example, where wireless is not available a field telephone line can be run to link up the control point with the nearest Post Office telephone or with a mobilising control. Unless the control point has been established in a room in which a Post Office telephone is installed, it will be necessary to detach a member of the crew to be stationed permanently at the nearest Post Office telephone, so that he can take incoming messages and send them on to the control point or despatch outgoing messages received from the control point.

The control point for a fire is the spot to which assisting appliances will normally be ordered to report, so that at large fires which demand the attendance of a considerable number of appliances, or where the streets surrounding the fireground are narrow, it is wise to place the control point well clear of the fire in a wide street or, better still, in a square where there is ample space in which vehicles

awaiting their turn to be sent on to the fire can park (Fig. 9). There is a tendency for reinforcing appliances ordered to a fire to approach too closely, thus causing congestion on the fireground and rendering it difficult to set appliances into the desired positions, since they may have to reverse considerable distances, an operation difficult with a trailer pump attached. Where the main control is set up at a distance from the fire, an advanced control point should be established in a conspicuous position in front of the fire, or, in the case of a fire zone, at a convenient road junction. The officer in charge of the fire or his representative should always be at this advanced control point, the position of which should, of course, be known to the control point proper. The various sketch plans of the fire which are prepared to assist firefighting should be brought to the advanced control point and placed, if necessary, in a car. Communication between the two control points will normally be by despatch rider but can, if necessary, be by field telephone.

In the case of an exceptionally large fire or of a fire zone, or where the fireground is intersected by a barrier such as a canal, the officer in charge of each side of the fire will usually find it desirable to have his own control point, which is then known as an auxiliary control point. Here, he or his representative will be found, and these points will again be linked, normally by despatch riders but sometimes by field telephone lines, with the advanced control point.

At large fires, a control unit should be ordered on in the same way



Fig. 9. Diagram showing the location of the control point, the advanced control point and auxiliary control points at a large fire.

as any other special appliance, since it carries all the requisite gear to enable it to function as a control. A description of a typical control unit is given in Part 2, p. 173. When an advanced control point is set up, the control unit should always be used as the main control.

The identifying marks of a control unit by day and night are described in Part 2, p. 174; those of an advanced or auxiliary control point are—by day a quartered red and white flag 2 ft. square, or a red flashing lamp; and by night two red hurricane lamps placed side by side or one above the other, or a red flashing lamp.

The more important considerations to which attention should be given when using a control point are :—

(i) Its location and the boundaries of the fire zone which it covers should be notified to the appropriate mobilising controls, and all officers on the fireground should be notified of its position.

(ii) A sketch plan of the building involved and of the surrounding area should be prepared, showing the building on fire, position of the appliances at work, and available water supplies. This plan, which should be fastened to a board (see Part 2, p. 174 for some suggested details) and placed in the most convenient position, provides the officer in charge of the fire with a general picture which will help him to decide upon the tactics to be employed.

(iii) Records should be kept of messages sent and received, the times of arrival of appliances, the attendance of officers, and of operations generally in connection with the fire. Copies should be made of any rough plans chalked on blackboards, which would otherwise be lost when erased, so that they are available later when reporting on the fire.

If an advanced control is in use, a log of operations should be maintained there also. This is of great help when it is subsequently necessary to prepare reports, for records can be kept of the progress of the fire, *e.g.*, the times at which various sections were brought under control, the collapse of walls, details of the setting in of appliances, etc.

(iv) The control point forms the intelligence and administrative centre for the fireground and acts as a liaison centre for all officers. Unless otherwise instructed, all officers in charge of appliances arriving at the fire should report to the control point. Senior officers arriving will be able to ascertain who is in charge and obtain information on the progress of the fire, the disposition of appliances, the state of the water supplies, arrangements made for reliefs and so on, and equally, the control point, through the mobilising chain, will be the medium for keeping senior officers who may be visiting the fireground informed of what is happening elsewhere in the territory for which they are responsible.

(v) The control point can provide the officers responsible for catering, transport and arranging reliefs, etc., with the necessary information, and can be used to give representatives of the Press such details of the fire as are authorised (see p. 99).

(vi) Adequate communications with the appropriate control of the mobilising system can be maintained.

Once the control point is set up and a sketch plan of the fire, together with the surrounding risks and water supplies, has been prepared, a clear overall picture of the situation can be obtained. In appropriate circumstances it may be desirable to bring together supervising officers and explain to them the tactics to be employed. They, in their turn, will acquaint their juniors with the measures which it is proposed to take, who will pass on the necessary information to their crews.

(h) *Bringing the Fire under Control.* From the outset of the operations, arrangements must be made for the branches to work in. They should be moved one at a time, and as each is temporarily shut down to add lengths of hose so that it can be moved further forward, it should be covered by others in the same group. Lines should be moved in by the officers in charge of the various sides of the fire on their own initiative. Not only the officer in charge of the fire but also officers in charge of specific sections, must be able to realise immediately the fire is coming under control. Apart from the reduction in heat and flame, the principal signs are a lightening in the colour of the smoke and the formation of visible steam.

The experienced fireman will know when the fire is coming under control and will have no hesitation in substituting a shut-off type of branch, changing to a smaller nozzle, or knocking off entirely, immediately the state of the fire warrants it. These steps will reduce water damage in the building and will economise in water supplies, which may well be required elsewhere.

(i) *Flooding.* The officer in charge of a basement fire may occasionally find it necessary to resort to flooding. This should only be done when it is impossible to reach the seat of the fire and when, after a considerable time, no improvement in the situation seems to have been achieved. Flooding must only be considered as a last resort when it is obvious that the stock is irretrievably damaged and after the most careful inspection of adjoining premises. Party walls between basements may not be strong enough to resist the pressure of the water and might conceivably collapse or, alternatively, may be sufficiently porous (due to poor mortar or cracked joints) to allow water to percolate through them and lead to a considerable amount of water damage in adjoining premises.

Flooding will only be practicable with certain types of building and when the basement is of reasonable size. Basements in large buildings of modern construction are usually very extensive, and flooding would be difficult owing to the volume of water required. Certain types of warehouse, also, are provided with extra large drains which would carry away the water and, if lavatories are installed, water may escape through them. Although drains would in all probability become blocked with debris, this would not necessarily happen. The best prospects of successful flooding are afforded by old buildings, which are often divided into relatively small compartments separated by load-bearing walls.

When a decision has been reached that flooding must be employed, then it should be done with maximum speed. Every available

pump should be got to work using open deliveries. The rate at which the basement fills up should be carefully watched to check that the water is not escaping and that adjoining premises are not being flooded. A rough measurement of the size of the basement involved will make it possible to calculate the rate at which it should fill with the capacity pumps in use. Flooding should be stopped immediately the fire is out, though it should be appreciated that it may be necessary to flood to the underside of the basement ceiling, if this is of wood and on fire. Pumps should then immediately be set in to pump out the basement *with as little delay as possible*. As there will usually be débris to choke the suction, strainers must be carefully watched and cleared from time to time. If it is necessary to enter the basement, and the stairs cannot be used, scaling ladders can be lowered through any available openings to give access.

(j) **General Considerations.** The following are a few of the many points to which the Fire Service officer must pay attention during the course of operations :—

(i) **Other Fires.** Cases have occurred of flying brands causing fires in buildings at some distance from the fire. In such cases it is usually advisable to send back a message so framed as to treat the outbreak as an entirely separate fire. It will then be dealt with by appliances despatched for the purpose. Where all pumps are in use on the fireground, it is usually quicker to take this course than to detach pumps which are already at work.

(ii) **Collapse of Buildings.** Depending on the nature of the fire or of the contents of the building, it may be necessary to post one or more competent officers or men to watch for signs of collapse of the structure (see Chapter 32).

(iii) **Reliefs.** If the fire appears to be going to last for a considerable time, arrangements for the provision of reliefs both for crews and for officers must be made. Records of the times of arrival and departure of appliances will be available at the control unit, so that requests can be made for reliefs well in advance of the hour at which they will be required to arrive. This will enable them to have a meal before going on to the fireground. Priority should be given to relieving those crews who have been longest on the fireground. Such reliefs may take the form of crews with their appliances or, less often, of personnel only, who can be brought on by suitable transport and who can take over appliances and equipment already on the fireground.

Where there is difficulty in detaching a pump from the fireground, owing to the congestion of hose or other vehicles around it or because much of its gear is in use, then the outgoing crew should take over the pump of the incoming crew and go home on it, leaving their pump at work with the relief crew. This will often be possible in large towns where appliances have had only a relatively short distance to travel to the fire, but may not always be convenient in rural areas.

(iv) **Supplies.** At a fire of considerable proportions, thought must be given at an early stage to the necessity for requesting

additional supplies of petrol, oil and any other consumable stores which are likely to be required. It will usually be the function of the transport officer to attend large fires and see that supplies of petrol and oil are adequate and that appliances are maintained in good running order. Knowing the number and type of appliances at work, a brief calculation will show approximately how much petrol and oil will be required. It may often be possible to prevent breakdowns in pumps at work by arranging for one or more mechanics to visit the appliances whilst they are on the fireground. It is also good for the workshops staff to see for themselves the conditions under which the vehicles for which they are responsible have to work.

When it is known that men will be employed for some hours at a fire, arrangements should be made to provide them with hot drinks and light refreshment by ordering a canteen van. An officer should supervise the arrangements. He should tour the fireground and inform the officers in charge of the various sides of the fire of its arrival, and should arrange for them to send a few of their men at a time to the van. It is their responsibility to ensure that men on the branches are relieved one or two at a time and that no one is forgotten. Where a meal such as can be provided by a canteen van would be insufficient, or where men are at work for long periods in an isolated locality where they cannot easily be relieved, a mobile kitchen (if available) should be ordered.

(v) *Use of Water.* If the fire appears likely to be of considerable duration, consideration should be given, once the fire is in hand, to shutting down any hydrants in use and employing open water, since it is wasteful to employ, for firefighting, purified water from the mains if unfiltered water is available. In the case of the smaller water undertakings also, the considerable quantities of water required at a large fire may severely tax the capacity of the local reservoirs. When considering the use of unfiltered supplies, however, care must be taken to ensure that the contents of the affected building are not such as will be damaged by dirty or contaminated water. Arrangements should also be made to utilise, by means of gulley dams, gulley curtains, pumping from sumps, etc., the considerable quantities of water which must necessarily run to waste at a large fire.

(k) *Making Up.* In normal circumstances, the senior officer will be the first to leave the fireground, and as the fire diminishes in size and intensity and crews are sent home, so will officers progressively junior in rank return to their stations. The rank of the officer in charge should, however, always be kept in proportion to current responsibility.

Before the officer in charge of the fire, whatever his rank, leaves the fireground, he should turn over to his subordinate, making it clear that he is doing so, mentioning any particular features to which attention should be paid and giving him any definite instructions that may be necessary. The transference of authority should be just as positive as when taking over control.

It is the duty of the officer in charge of each appliance to see that

none of his gear is left behind or, where this is unavoidable, to make a list of such gear, so that arrangements can be made to recover it after the fire.

(1) *Officership.* The officer in charge of a fire must never overlook the fact that upon his bearing will depend that of the crews working under him. He should at all times appear imperturbable, and any orders which he gives should be given clearly and simply and without shouting or sign of excitement. It is a tradition of the Fire Service that it works without unnecessary noise.

The duty of the officer in charge at a fire is to size up the situation as a whole and issue the necessary orders. Self-confidence, experience and the ability to make quick decisions are therefore essential. An officer should never send men into a position in which he would not go himself and, in fact, when it is necessary to station men in an obviously dangerous position, a good officer should go in with them and remain with them until he is confident that it is safe for them to be stationed there. The function of an officer is to lead and control, and he should never himself do manual work, for this is the *role* of his men.

A point which is often overlooked is that all officers on the fireground should be correctly dressed in fire kit and should insist that all crews are dressed likewise. Men cannot be expected to keep neat and tidy when firefighting, but slovenliness such as allowing the belt to hang loosely out of the tunic begets the Service into disrepute.

AFTER A FIRE

IN this chapter it is proposed to survey the more important points which the officer in charge of a fire should bear in mind as soon as the later stages have been reached and before it is finally left.

1. MAKING UP

Immediately the fire situation permits, the officer in charge will order a proportion of appliances to make up and return to their stations. He should give priority to escapes and other special appliances and then to those crews which have been longest on the fireground.

As far as possible, an appliance should always return to its station in a condition in which it could, if necessary, immediately respond to another fire call. Any gear which has been taken off the appliance and subsequently not used should, as a matter of routine, be collected and restowed on the appliance. Hose should be under-run and rolled, wet hose being carried in a suitable place on the appliance and not in dry hose lockers. In the case of damaged hose the overhand knot put in lengths taken out of use (see p. 30) should be untied, and the hose should be rolled the reverse of the correct way. Lines should be properly made up before being stowed, and care taken generally to see that all equipment is replaced in its correct position on the appliance. Any equipment which has been in contact with acid, etc., should be stowed so that it does not damage other gear.

It is the responsibility of the officer in charge of an appliance to see that his gear is complete, or that, if operations necessitate his leaving any equipment on the fireground, he has a list of the missing gear, and that, on his return to his station, any such deficiencies are entered in the general log. It is customary for the driver of the appliance to be made responsible for seeing to the completeness of the gear carried. Alternatively, where a large fire has necessitated the use of a considerable quantity of equipment, it may be desirable to arrange for all gear to be brought to a convenient centre, where it can be cleaned, repaired if necessary, sorted and returned to its proper stations.

2. DAMPING DOWN AND TURNING OVER

As the fire comes under control so branches are moved in closer and then finally shut down. After the main body of fire has been extinguished, the next step is to eliminate any remaining pockets of fire so that re-ignition cannot occur. Except where approach is rendered especially difficult by collapsed floors, etc., it will generally be possible to get close to any residual burning material, since it will only be smouldering, and only relatively small quantities of water will be required to complete the extinction of the fire. Thus, as

early as practicable, the size of nozzles and pump pressures should be reduced, or, where water is only required at intermittent intervals, hose lines should be connected to hydrants, and shut-off, or diffuser branches should be brought into use. Greatly increased manoeuvrability is obtained if hose reel tubing is employed, and connected to the full sized hose lines by means of hose reel adaptors. The hose reel shut-off nozzle is also valuable as giving added control, or, if this equipment is not available, $1\frac{1}{2}$ -in. hose with a hand-controlled or diffuser branch can be used. Alternatively, when only very small quantities of water are required, hand pumps or buckets may be employed. Any practicable measures of this kind should be taken to prevent unnecessary water damage and also to reduce the consumption of water.

When small nozzles are in use, dividing breechings can, in many cases, be inserted in the hose lines, and if these are connected to hydrants, surplus pumps can be sent home. Where it is not possible to use hydrants in this way, the fewest pumps possible should be employed to feed the hose lines, and any surplus returned to their stations. It will normally be the case that the number of appliances retained on the fireground will be dictated by manpower requirements rather than pumping capacity.

When branches at work inside a building are shut down prior to making up, a coupling *outside* the building should first be broken to allow the hose to drain and the water to flow to a place where it will not do damage. The hose should then be under-run from inside the building before the individual lengths are uncoupled.

A feature of all large outbreaks is the amount of *débris* underneath which small pockets of fire can continue to smoulder for considerable periods. Fire may be buried by the collapse of floors, but gradually it will burn its way out and will be evident by the rising smoke and heat. Steam, however, should not be confused with smoke. As far as size permits, all *débris* in such premises as private houses, offices, etc., should be turned over and well spread out to prevent re-ignition. This should be done either by removing the *débris* to an open space, or, if this is impossible, by clearing a space and then methodically turning over the *débris* on to it, gradually working from one end of the affected area to the other, while a hand-controlled branch, hose reel jet or hand pump is used to damp down as may be necessary. It is useless to pour water on to *débris* in the hope that the fire can be drowned out without turning over.

Baled goods such as cotton; rolls of paper, etc., should not be broken open and spread out in this way. If it is necessary to open a bale which is suspected to be on fire internally, it should be removed from the affected building and taken into the open air, preferably to a clear space such as a yard or field, in which it can be spread without risk of fire. Water should, of course, be available during this operation to deal with any possible outbreak.

Where a considerable quantity of turning over has to be done in industrial premises, it is usually possible to obtain the assistance of works personnel, and the use of equipment such as trucks and barrows. If the property is covered by a Works Fire Brigade, it

will usually be desirable to hand over the fire to them as soon as practicable, in order that Fire Service pumps may be returned to their stations.

The following description of the method used in turning over by a regular Salvage Corps is of interest, as showing the care with which the work is done in cases when it is necessary to check an insurance claim. "Two men are sent to the ruins with a sieve and shovel. A start is made in one corner of the débris-covered floor, a small portion of which is scraped clear. Pieces of timber are used to build improvised bins, after which the whole of the débris is passed through the sieve. In one of the bins are placed large pieces of ironwork, in another timber, in another anything that will identify an item in the claim. Other bins are formed as may be necessary, a large one being provided for large burnt embers and dirt. Nothing is thrown away, and everything is kept until the claim has been checked. It may happen that a bin of buttons must be counted to check a claim for clothing, piano pegs for pianos, clasps for purses, nickel bands for pipes, hinges and knobs for cabinets and so on."

A thorough search and examination should be made of all parts of the building and any adjoining property likely to have been affected (especially any with broken windows), to see that no traces of undiscovered fire remain. Large areas should be thoroughly damped down with small jets or diffuser branches, whilst bull's-eyes* in difficult positions may require the use of small high-pressure jets. (Bull's-eyes are especially liable to be found where joists run into walls.) Woodwork, such as panelling, skirting boards, lintels, window frames, joists and beams where they enter walls, and wall-plates in those cases where a roof has been involved, behind all of which there may be traces of fire, should be tested by hand for signs of heat, and, if necessary, cut away. The sash cords of windows should always be examined in a room where there has been a fire. Should the cords burn through, they will run over the pulleys and into the weight recesses at the side of the window, where they may smoulder for some time before setting alight to the usual accumulation of dust in these recesses.

Fire is very apt to lurk in padded furniture such as chairs, settees and beds and, in the case of a small fire, it is often preferable to remove them outside in order to complete extinguishing operations. This has the advantage that they are then often more accessible, and there is no risk of smoke and water damage. Goods removed in this way should, of course, be returned after the fire has been

* The term "bull's-eye" is used in the Fire Service to denote those small cores of burning material which are often found to remain in beams, panelling and other woodwork after the main fire has been extinguished. If these are not dealt with they may smoulder for long periods and subsequently cause a recurrence of the fire. They can normally be extinguished by small jets, but it may sometimes be necessary to cut them out with an axe. They are often found in the most unlikely positions, and a careful search is therefore necessary. In darkness they can easily be found by extinguishing all lights. In daylight a good way of detecting bull's-eyes is to play a small jet, such as that from a hand pump or hose reel nozzle, on to the suspected places, when rising steam will betray their presence.

extinguished, or, if this is impossible, should be covered with salvage sheets to protect them from the weather.

Cases have occurred where, before the arrival of the Fire Service, the occupiers have removed from the affected part of the building, upholstered furniture such as armchairs which, unknown to them, contained undetected fire that subsequently burst into flame. Enquiries should always be made as to whether furniture has been removed in this way.

Finally, it should be emphasised that much unnecessary damage can be caused by careless cutting away, removal of undamaged contents, and excessive use of water. There is a Fire Service proverb which runs: "It is our fire but it is their house," and the idea at the back of this phrase should never be lost sight of during or after operations. Occupiers greatly appreciate the Fire Service making as little mess as possible, putting paper on chairs, for instance, before men stand on them, and other considerate actions of a similar nature.

3. SPRINKLERS

Before the officer in charge leaves the fire it is essential that he should see that the sprinkler heads (see the Chapter on "Sprinklers, etc.") which have operated are replaced and the system recharged, so that the building is not left without sprinkler protection. Normally this will be done by the salvage squad, if the fire has been attended by a detachment from a regular Salvage Corps, or by the engineer or other members of the staff of the building. Otherwise, spare heads when available should be replaced under the direction of the officer in charge of the fire, care being taken to see that the type of head is the same as that already in use. A stock of spare heads will usually be maintained in a locked glass-fronted box near the main stop valve, the glass of which can be broken if the key is not to hand. If spare heads are not available, the system must remain shut down and a notice to that effect must be displayed prominently on the stop valve. The manager or other responsible person must be notified, in order that he may make his own arrangements for getting the system recharged. In some localities a special fitting is carried on certain appliances by means of which a head which has operated can be sealed off (if a spare head is not available) so that the system can be recharged immediately.

Where a sprinkler system consists of several self-contained and separate sections, only that which has operated, which will be indicated by the gauges (see the Chapter on "Sprinklers, etc.") will normally have been closed by the fireman given the order to shut down. The gauges of the other sections of the system should, however, be inspected to see that they have not operated, and a rapid patrol of the building should be made to verify that no head is discharging. The plan of the system, which will usually be found near the valves, will enable this to be done with a minimum of difficulty. The number of heads which have actuated will of course have been noted, since this information will be required in connection with the report on the fire.

4. DRY RISERS

Any dry risers which have been charged should be drained by opening the valve near the inlet ; if an automatic air valve is not fitted at the top of the riser, the highest practicable hydrant should be opened in order to allow air to enter and thus release the water. Internal hydrants should be checked to ensure that all valves are closed, and, if hose in cradles has been used, the occupier of the premises should be reminded of the necessity for arranging for it to be dried and restowed.

5. REMOVAL OF BODIES

The fireman should bear in mind that bodies which have been burnt are sometimes difficult to recognise as such, and may be found in most unlikely places. The peculiar smell of burnt flesh will prove an indication of the presence of bodies in a room or building. When a body is found in circumstances in which it is obvious that life must be extinct, the Fire Service should not normally make any attempt to move it, since the matter is essentially one for the Police, who will wish to obtain full information for presentation at the subsequent inquest.

Where, however, there is any reason to believe that the victim is alive, or where the body might become involved in any spread of fire, then it should be removed with as little disturbance as possible. Before touching a body, a careful note should be made of every factor which might be of importance, *e.g.*, where the body was found and the position in which it was lying, and, if a photographic section is maintained, and life is obviously extinct, photographs should be taken. In some parts of the country, body sheets are carried on appliances, and are employed for the removal of remains, but if these are not available then a jumping sheet, blanket, salvage sheet or tarpaulin may be employed. It may also be necessary to use a scaling or other ladder as an improvised stretcher. An ambulance will have been ordered and the body should be handed over to the ambulance attendant. If life is obviously extinct, the police will make the necessary arrangements for the conveyance of the remains to the mortuary.

Material or articles such as clothing, buttons, studs, etc., which may fall from the body when it is moved should be recovered and handed to the Police, as they may assist in the identification of the body. For example, in a serious bus fatality in which several persons lost their lives through fire, these objects were of great value for identification purposes.

A fireman should take the greatest care not to use his bare hands if it is necessary to lift a body, either human or animal, since, if he has any open cuts or abrasions on his hands, blood poisoning may under certain circumstances be set up. Bodies should be lifted with gloved hands, or by means of spades placed underneath them. If a fireman has had to touch a body, the use of a suitable disinfectant is always a wise precaution, while if the fireman has cut himself and subsequently touched a body he should see a doctor as soon as possible.

6. ANIMALS

Animals which have been involved in a fire should normally have been removed at an early stage. If the dead bodies of domestic pets or other animals are found during clearing up, however, they should be removed and deposited in a garden, yard, or other convenient place, in the care of the occupiers or their neighbours. Consideration should always be shown, even in the case of dead animals, since it should be remembered that their owners may have been very much attached to them, and any callousness on the part of firemen will serve to aggravate their distress. In difficult cases it may be possible to obtain assistance from the local official of the Royal Society for the Prevention of Cruelty to Animals. Alternatively, the occupier may wish to summon a veterinary surgeon, and every assistance should be given him to do so.

A more detailed treatment of the action to be taken where animals are involved will be found in Chapter 36 (p. 186).

7. CAUSE OF THE FIRE

One of the most important tasks of the officer in charge, before he leaves the premises, is to ascertain the cause of the fire. Statistics based upon the causes returned by Fire Service officers are used for many purposes, and it is therefore of great importance that the cause should be ascertained wherever possible and that this, as well as all material circumstances of the fire, should be accurately stated in the Fire Service report. Where, after careful investigation, if necessary with expert assistance, the officer cannot decide upon a cause with reasonable certainty, then the origin of the fire should be returned as "unknown." No attempt should ever be made to guess at a cause merely to complete a return.

In most small fires the cause will be obvious, for the damage will not be sufficient to have destroyed the evidence of origin. In some large fires also, it will be ascertainable without difficulty, whilst in a considerable proportion of fires, both small and large, the occupier will be able to describe what happened. Failing such information, however, the Fire Service officer must rely on his own investigations.

The first step is to ascertain whether there is any clear indication as to where the fire started. As a general rule, when the fire is not extensive, it may be assumed in the first place that this point will be in that part of the building where greatest burning has taken place. Examination of a work bench, for instance, will show whether the fire started on or underneath the bench. A door may show on which side the fire was fiercest, and the degree or depth of charring of woodwork will often provide a clue.

The fire may, however, not always have started at the point of greatest burning for, if the fire is extensive, this may have occurred where easy access of air coincided with the presence of the most readily inflammable material. The fire may, for instance, have originated in an upper floor from a comparatively minor cause, burned through the floor and fallen on to highly inflammable stock

below. Alternatively, fire may, and often does, drop down lift shafts, light wells and so on. The nature of the contents and construction of a building may, therefore, give a hint where this has occurred. It is also not unknown for a fire to jump one or more floors, or where a fire on a lower floor has spread by way of the windows, several floors higher up the building.

When the seat of the fire has been found, the cause may be easier to determine, but in order to do this accurately the officer requires not only powers of observation, inference and deduction, but also a knowledge of the more usual causes of fire. Though a junior officer may, under ordinary circumstances, be expected to decide the cause of a fire, he should never hesitate, if he is in any doubt, to ask for the advice of a senior.

Among the factors which may have to be considered when trying to arrive at a decision are :—

(a) The type of premises involved, together with the processes carried on, the commodities stored and the hazards inherent in them.

(b) The time and circumstances of the call.

(c) The results of the examination of the point of origin and its immediate surroundings, as well as the direction of spread.

(d) The state of the electrical installations (including whether switches are on or off) and especially the wiring and fuses. The presence of oversize fuse wire, or incorrect substitutes, for instance, would point to the possibility of an electrical fault.

(e) The condition of gas pipes, and whether cocks and taps are on or off.

(f) If the fire has started near steam pipes, the degree of charring of any adjacent materials.

(g) Where static electricity may be a possible cause, whether earthing arrangements are satisfactory.

(h) In premises where smoking is prohibited, the possibility of surreptitious smoking and the hurried disposal of cigarette ends.

(i) Whether "good housekeeping" is observed at the premises, or whether excessive dust and waste from machines have been left lying about on the floor and the machinery.

(j) Whether the fire was caused by sparks transmitted through ducting, etc., from another part of the premises. For instance, foreign material introduced either wilfully or accidentally into breakers or disintegrating machinery may cause sparks and initiate fires. If the material from such machines is conveyed by belts, forced draught or suction, the fire may be carried along undetected and break out in another part of the building.

In addition, useful information can be gained from those who were present on the premises at the time of the outbreak, but caution is necessary in accepting the statements made. In most cases the management, owners or occupiers will be willing to assist, but it should be remembered that information which is volunteered may occasionally be intentionally misleading or deliberately false. For instance, the cause may be known, but it may be feared that trouble

will result, or that the insurance claim may not be paid if the whole circumstances are revealed.

If it is proposed to interview workpeople, the permission of the management or the owners should first be obtained. Each person should be interviewed separately, beginning with the junior members, and particular attention should be given to the person who discovered the fire or who was last in the part of the premises concerned, since the length of time elapsing before the fire was discovered is often a useful clue. Anyone who is questioned should be put at his ease; for it should be remembered that many people are under the false impression that a charge of arson can arise out of a fire which has been caused by carelessness. It should also be remembered that the Fire Service officer in this country has no legal right of interrogation, and people cannot therefore be compelled to answer his questions.

Remarks made by workpeople or bystanders to each other during the fire may sometimes provide a clue to its cause, and a fireman overhearing remarks which might have any bearing on the matter should always report them to his officer. It must be emphasised, however, that information obtained in this way should not be regarded as conclusive, but only as giving a pointer to visible or other evidence provided by inspection of the seat of the fire itself. It is always unwise to base a conclusion on a single statement, however obtained, without visible evidence or corroboration from other workpeople.

If there is still doubt, then it may be helpful to make a comprehensive list of possible causes, and progressively eliminate those which appear to be impossible or unlikely, till that which is most probable is left. Spontaneous ignition is a well-known cause with certain commodities, but care should always be taken to obtain confirmatory evidence before returning this as the cause of the fire. An officer should be extremely careful in citing the cause of a fire as anything but the "supposed" cause. If there is an element of suspicion and the matter is handed over to the Police for investigation, the cause should be given as "doubtful." Where life has been lost or persons may possibly die later, the form should not be completed until the inquest has taken place or it is known that no inquest will be held. It is the responsibility of the jury to give the cause of death after hearing the evidence, and the Fire Service officer when giving evidence should, of course, state what he knows but should so present the facts that the jury can arrive at their own decision.

8. THE DETECTION OF ARSON

To ascertain the cause of a fire which is the result of arson may call for considerable experience, and whenever there is cause for suspicion the Police and a senior officer should at once be notified and the attention of the Police drawn to whatever evidence is available. The Fire Service officer should, in such circumstances, make careful notes (preferably at the time, but, if this is not possible, immediately he returns to the station), of all relevant particulars,

in case he is subsequently called upon to give evidence at an enquiry. It is not unknown for a Fire Service officer to be called on to give evidence as long as two years after the event.

Malicious fires may result from the actions of five main classes of person. They may be caused by :—

(a) weak-minded persons or pyromaniacs, who generally employ simple agents such as paraffin, matches, etc. ;

(b) employees who labour under a grievance or are under notice of dismissal ;

(c) those intending to defraud an insurance company ;

(d) those intending to destroy evidence of a more serious crime ;

(e) persons instigated by jealous competitors.

In the first case a few discreet enquiries, particularly with regard to the movements of individuals, will sometimes give a clue to the cause of fire.

In the other four instances much careful investigation may be necessary to obtain sufficient evidence to substantiate any statements that might be made in any subsequent proceedings.

Arson may reasonably be suspected in cases where :—

(i) several separate fires occur more or less simultaneously ;

(ii) a fire has occurred in an improbable place ;

(iii) there is no apparent cause and the normal fire risk is low ;

(iv) the behaviour of the burning material is unusual ;

(v) substances and materials are found which would not normally be used on the premises and which would cause or assist combustion, *e.g.*, candles or candle grease.

(vi) unusual and characteristic smells such as those of petrol, paraffin or celluloid are detected ;

(vii) the same person is present at more than one fire or raises the alarm on different occasions (*e.g.*, to obtain credit for discovering the fire) ;

(viii) a series of fires occurs at the same premises in a fairly short space of time, particularly if the several fires possess similar features ;

(ix) buildings are obviously stocked with materials of little value in relation to the known occupancy ;

(x) a small fire, with no apparent cause, has destroyed records, such as National Health Insurance cards, cash books, etc.

To assist in any subsequent investigations at a fire where arson is suspected, every effort should be made, during and after the firefighting operations, to preserve any possible evidence without disturbing it. Once the fire is extinguished, the building should be left in charge of the Police.

9. MAKING SURE THAT THE FIRE IS OUT

It is the responsibility of the last officer to leave the fire to make quite sure that it is completely extinguished. It would be a grave reflection on the Fire Service to receive a second call to a fire which had been left as having been extinguished, and every effort should be made to ensure that no bull's-eyes, pockets of fire beneath debris, or other possible causes of re-ignition remain. Cases have occurred in which burning materials have lingered in the most unlikely

places. At one fire, for example, dust which had become ignited on the top of a beam travelled some 20 ft. along the beam and ignited the roof timbers at the side of the building some hours after the fire was believed to be out. Particular care should be taken with hearth fires, since, if every possible trace of burnt or charred timber is not removed, the timber may re-ignite as soon as a fire is again lit in the grate.

If any doubt remains in an officer's mind, a fireman, or, if necessary a pump's crew, should be left behind as a watching party until it is certain that any recurrence of the fire is impossible. Alternatively, an officer or man could be detailed to visit the scene of the fire at regular intervals until it is quite certain that nothing further can develop.

10. CLOSING UP THE PREMISES

If the occupier of premises which have been on fire is not present the Police, if they know his identity and whereabouts, will normally notify him of the occurrence, but the Fire Service officer cannot necessarily count on this being done. If, after the building has been cleared of smoke, the occupier still cannot be contacted, the windows should be closed and outer doors shut before the firemen leave. In some localities hasps, staples and padlocks, together with fixing screws, are carried in order to secure premises which have been forcibly entered. Where it has been necessary to effect an entry by breaking in, and it is found impossible effectively to close the building, the Police should be asked to take charge, and should be handed any items of jewellery or money (for which a receipt should be obtained), and notified of damaged gas meters or telephone boxes containing money. Where, however, a salvage squad has attended, the Fire Service officer will turn the premises over to the officer in charge of the salvage squad. It should be noted that the Fire Service is not entitled to keep the occupier out of the premises once the fire has been extinguished (see also p. 49).

A final inspection should be made by the officer before he leaves to ensure that, if the utility supplies to the premises have been affected, the gas has been turned off at the meter, the main electricity switch opened and the fuse withdrawn, and the water cut off at the main. Lead water pipes which have been damaged can often be flattened to prevent water continuing to leak. Unless it is known that a representative has already attended (as will often be the case with large fires), the appropriate public utility undertaking should be informed when the service has been affected. If there is any doubt as to the safety of the building, the Surveyor to the Local Authority will have been notified either by the Fire Service or by the Police. Should he certify the building as dangerous, it will be the responsibility of the Police to prevent the occupier from re-entering and to divert the traffic should this be necessary.

11. THE GIVING OF INFORMATION

The Fire Service officer should, as far as operations permit, give the Police any information for which they ask, and answer any

reasonable questions put to him by the occupier, but he should be guarded in his statements, since these may be quoted later and further evidence may come to light which might cause him to alter his original opinion. He should not make a statement over matters where a difference of opinion is likely to arise, perhaps in connection with a legal claim, nor should he give an opinion as to the cause of the fire. On insurance matters, the occupier should be referred to the insurance company. The Fire Service officer is always correct in drawing the attention of a Salvage Corps officer to any circumstances which appear suspicious.

Journalists are usually given relatively full information, though this may be inadvisable in special cases, especially if it is possible that legal proceedings may ensue. Such information can include the names of the officer in charge and of other senior officers, the number and types of appliances attending, the stations from which they came and the functions which they are designed to carry out, the time of the call, whether any rescues were effected and a general description of the firefighting measures and of the fire damage to the property, though care must always be taken not to reveal information of a confidential nature gained in the course of the Fire Service operations. Members of the general public should not usually be given information unless they have a special interest, though there may be no harm in explaining the reasons for the use of various items of equipment, so long as firefighting operations are not interfered with. Remarks reflecting on the efficiency of the Service should never be expressed by firemen, either to the public or to each other within the hearing of strangers.

12. BEFORE LEAVING THE FIREGROUND

(a) *Hydrants.* Before the officer leaves the fireground, all hydrants which have been in use should be inspected to make sure that the valves are properly closed and that the frost valves are working. Pits should be cleared of any debris which has been washed into them, and baled out if necessary.

(b) *Fire Alarms.* Before the Fire Service crews return to the station, any fire alarms which have been actuated should be rewound or reset, a new glass inserted, and the alarm tested. It is generally desirable to arrange that this should be done by the crew of the appliance from the station on whose ground the fire alarm is situated, but it is the ultimate responsibility of the dutyman to ensure that this is done. If it is suspected that more than one alarm has been actuated for the same fire, it will be good policy to ring up the station to ascertain which alarms have been used, so that all can be inspected to see that they are ready for action. In the case of automatic alarms installed in premises which have been affected, and which have actuated, the Alarm Company should be notified, if this is not done by the operation of the alarm itself.

(c) *Hose Reel Tank.* If the hose reel equipment has been in use, steps should be taken to replenish the hose reel tank before the appliance leaves the fireground. This will ensure that it is immediately available for use should it be required to deal with a fire

encountered on the way home. It is good practice, especially with small hose reel tanks, to recharge the reel to the nozzle when filling the tank, so storing as much water as possible.

13. ON RETURN TO STATION

(a) *Equipment.* On the return of the appliance to the station, arrangements should be made to fill the places of any members of the crew injured or left behind on the fireground. The required number of men at the station should then be turned out to assist in restowing and getting the appliance back on the run ready to attend further calls. All gear which has been used at the fire should be examined, cleaned, and where appropriate, tested. Defects in any gear used during operations will have been noted and, on return to the station, steps should be taken to rectify them at the earliest moment, or to substitute reserve equipment. The driver should at the same time check the appliance over to ensure that it is in good mechanical condition, make any necessary entries in vehicle log books and so on. *It must be emphasised that getting the appliance back on the run should take priority over all other considerations, and if it is impossible to provide sufficient reliefs to do the work, members of the crew should not be allowed to leave the appliance until this has been done.*

The following are the more important items to which attention should be paid if the equipment has been used :—

Pump. Wash out and drain, if dirty or salt water has been used, or if foam compound has been passed through it, e.g., when using a multiple jet or suction inductor.

Appliance. Check petrol, oil and water and leather down. Inspect tyres for stones, glass, etc.

Escapes, Ladders, etc. Examine and test.

Lines. Dry, examine and test. If contact with acid, etc., is suspected, dry and place in store for at least a week before testing. Replace by spare lines.

Extinguishers. Recharge.

Hose. Replace with spare. Clean, test and dry.

Hose Fittings. Replace or repair any found defective.

Breathing Apparatus. Thoroughly clean, recharge and test.

Hose Reel Tank. Check to see that the tank is full. This should have been replenished before leaving the fireground.

Small Gear. Check and enter any shortages in the general log, making up if possible from reserve stock pending the return of gear left on the fireground.

Lamps. Clean, check and dry, replace batteries or recharge accumulators.

(b) *Plans.* At any fire where a death has occurred or there were grounds for suspicion as to the cause of the fire, a sketch plan of the room or building should be made. The information recorded should include the lay-out of branches and the general plan of operations at the fire. Such plans are not only useful for personal study but may also be of assistance if it is subsequently necessary to give evidence at an inquest or enquiry.

14. FIRE LOG AND FIRE REPORT

The fire log should be inspected, to see that all relevant facts have been recorded and, if necessary, a revised message sent to the higher control.

The fire report will be prepared by the officer in charge of the ground on which the fire occurred, who should therefore be careful, if he attends the fire, to keep a record of all necessary information, or detail a subordinate to do so. Officers who will be responsible for furnishing information from which the fire report will be compiled, should be sufficiently well acquainted with the particulars that are required to be able to obtain the necessary information on the fireground without referring to the form. The preparation of an accurate and concise report is an important part of the work of every Fire Service officer.

Inquests, courts of enquiry, criminal proceedings and litigation resulting from fires are not infrequently dependent at some stage on the evidence of Fire Service witnesses, and accurate observation and careful investigation are therefore essential.

15. FIRE PROTECTION

If no representative of the Fire Protection Section is present, the officer should, whilst he is at the fire, take note of any matters which might be of interest to those responsible for fire protection. The following are among items with which the Fire Protection officer will be concerned :

(a) whether sprinklers and drenchers operated correctly and proved adequate ;

(b) whether automatic fire alarms operated correctly ;

(c) whether self-closing fire-resisting doors operated, or were prevented from closing by obstructions ;

(d) whether hand-operated fire-resisting doors were found open or closed ;

(e) whether fire-resisting doors failed or collapsed ;

(f) whether fire-resisting glazing proved efficacious ;

(g) whether internal hydrants, hose reels, etc., were in use and proved satisfactory ;

(h) whether there were any violations of fire protection requirements, such as corridors, fire lanes or staircases obstructed with stock, or exit doors locked or barred ;

(i) whether there were any violations of regulations or bye-laws regarding the storage of hazardous goods.

16. LESSONS LEARNED

After a fire it may sometimes be valuable to hold a discussion to see whether methods could have been improved or whether the situation was handled in the best possible manner. Diagrams should be prepared for such analyses—they will help to check such points as the correct siting of branches and whether or not the best use was made of available water supplies. In the case of a large fire the chromoid sheets bearing sketch maps of the fireground referred to in Part 2, p. 174, may be found useful, as will also copies of the relevant fire logs and a map of the water supplies.

PART 6A CHAPTER 35

METHODS OF ENTRY, CUTTING AWAY, ETC.

FORCIBLE ENTRY

THE powers of a member of the National Fire Service to break into premises in the course of firefighting operations are covered by paragraph 14 (i) of the Fourth Schedule of the National Fire Service (General) Regulations, 1944,* which states :—

“ Any member of the National Fire Service being on duty (as well as any police constable) may enter and if necessary break into any premises or place in the United Kingdom or the Isle of Man in which a fire has or is reasonably supposed to have broken out, or any premises or place which it is necessary to enter for the purpose of extinguishing a fire, without the consent of the owner or occupier thereof, and may do all such acts and things as he may deem necessary for extinguishing fire or for protecting from fire any such premises or place or rescuing any person or property therein.”

If possible, a building should always be entered by a door or window, if these can be opened without damage. Failing this, entry should whenever possible be made by the method which will cause least damage. Thus, with certain exceptions listed below, when force must be used it is preferable to break glass rather than wood.

A fairly extensive list of means of entry is given below, but it must be emphasised that this is for information only and it by no means follows that the means of entry should be tried in this order. Whenever considerable difficulty in breaking in is expected or experienced, every endeavour should be made to find an alternative way in.

It should be understood that the methods described below will not be employed solely to gain initial access to a building. It is often necessary, during firefighting operations, to open locked doors inside the building to gain access to other parts of the premises or to allow hose or other equipment to be passed through. Similarly, such operations as cutting away woodwork are more commonly employed during the actual fighting of the fire than to provide a means of entry, but seeing that they may have to be used on occasions for this latter purpose, all operations of this nature have been included in this chapter.

Since the saving of life is the first consideration of the fireman, it must be emphasised that if life is believed to be at stake then, irrespective of any other factors, the quickest way in should always be chosen. This will also apply in most cases when the fire can be seen to have secured a hold on the premises, for damage due to failure to attack the fire promptly would in almost every case far exceed the damage due to entry. The methods described are those which would be employed when it is necessary to enter to investigate.

* Statutory Rules and Orders, No. 1077 of 1944.

The easiest way into an unoccupied building will always be by the way the occupier left it, for it will of necessity have been locked up on the outside at this point.

Almost all buildings have at least one secondary entrance, a back door or tradesman's entrance in private houses, and a goods entrance in commercial or industrial premises. It is often the case that side or rear doors are not kept in such good condition as the front door. If there is no side entrance, the quickest way to the rear of a building will usually be by way of adjoining property, through which a short ladder can be carried for scaling walls, reaching first floor windows, etc. If a man has been sent in by an alternative entrance to open up a door from the other side, it may assist him to find his way to the correct place if those waiting for him to open up, knock or bang on the door.

1. DOORS

When seeking entry to a building, the principal entrance should first be tried, unless there are definite reasons against it, since this usually gives access to the hall or stairs, whence the rest of the building can be reached. If the door is shut, the handle should be turned to see if it is fastened, for doors have on occasion been broken open under the misapprehension that they were locked. It is in any case always a good plan to call out or knock loudly before effecting an entrance, as there may be people in the building who are unaware of the fire; cases have even occurred in which a front door has been broken open when firemen had already entered the building from the rear. Doors may on occasion be of considerable value because of special features such as stained or plate glass, special woods, etc., and, rather than break in doors of this kind, an alternative means of entry should be sought unless conditions are such that it is imperative to enter without delay.

Doors, shutters and gates are of seven principal types and each requires special treatment in order to force it with the minimum of damage :—

- (a) Hinged doors ;—
 - (i) ledged.
 - (ii) panel
 - (iii) flush } (Framed types).
 - (iv) steel covered.
 - (v) barred.
- (b) Swing doors.
- (c) Revolving doors.
- (d) Sliding doors.
 - (i) solid type.
 - (ii) steel lattice type.
- (e) Folding doors.
- (f) Cantilever doors.
- (g) Roller shutters.

It should be noted that in many gates and doors of industrial premises a small door, often referred to as a wicket gate, may be

inset ; e.g., a hinged door set in a sliding gate. This small door should always be first tried.

(a) *Hinged Doors.* Hinged doors closing against a rebate on the door jamb are by far the most common type of door. They may open either toward, or away from, the operator.

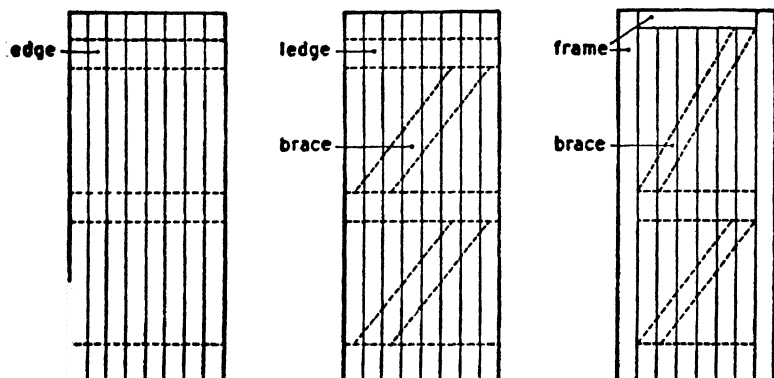


Fig. 1. Diagrams showing typical doors. Left : ledged. Centre : ledged and braced. Right : framed and braced.

(i) *Ledged.* This is the cheapest type of door to construct and, except when installed in well built houses because of its antique appearance, is usually of flimsy construction. The two types normally found are shown in Fig. 1. These doors are usually

fastened by very light fittings and will generally yield to a push from the shoulder or a stout kick from the fire-boot. A good method of kicking open a door is shown in Fig. 2. The body must be poised so that the sole of the boot meets the door either flat or with the heel slightly in advance.

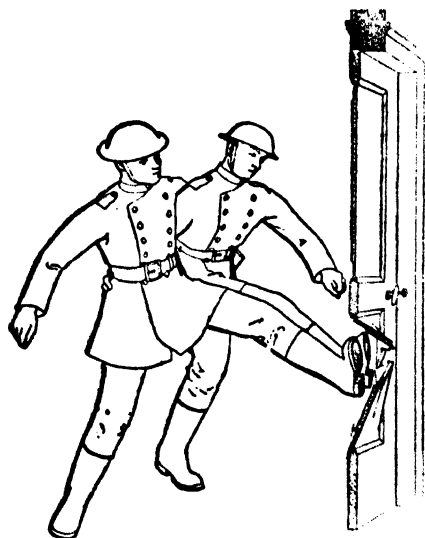


Fig. 2. Sketch showing one method of kicking in a door.

(ii) *Panel.* Panel doors (Fig. 3, left) usually have a wood framing, with wooden, or, sometimes in the upper half, glass panels. The glass panel should be broken first and an endeavour made to unlock the door by passing the hand through to the inside. If the panels are all of wood then a bottom panel should be selected, since if it is still impossible, when

the panel has been forced, to open the door from the inside the fireman will not injure himself as he climbs in. Moreover, if hose has to be taken into the building it will not be kinked and possibly damaged, as it might be if it were suspended halfway up the door. The panel may be broken with the large axe.

When getting through an opening made in this way it may be wise for the fireman to take off belt and axe, for it is easy to become jammed in a narrow panel opening. Even though the axe is temporarily removed in this way it should never be left behind, as it has innumerable uses and may well be required for further breaking in, cutting away, etc.

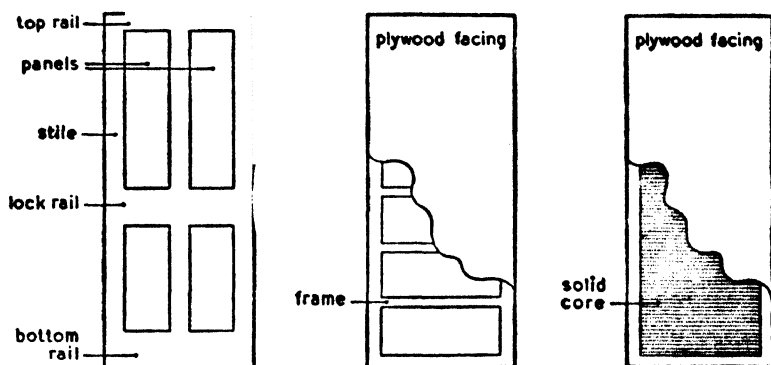


Fig. 3. Diagrams showing typical doors. Left : panel door. Centre : flush door, skeleton type. Right : flush door, solid core type.

If, however, it is suspected that a person is lying behind the door (as, for example, if the door has been opened a few inches but, though a chain is not fitted, it will not go further), then the *top* panel should be broken, lest the efforts to break in should injure the person behind the door.

(iii) *Flush*. This type (Fig. 3, *centre and right*) may be either hollow or solid, in the former case being strengthened by a number of cross-members. Cutting through is a difficult undertaking, and an attempt should be made to lever the bolt of the lock out of the lock plate. If this is impossible an alternative means of entry should be sought before attempting to cut away.

(iv) *Steel-covered*. This type (Fig. 4, *left and centre*, and Fig. 5) presents the same difficulty as the flush door, but to a greater degree, since it is impossible to cut through a steel-covered door with an axe. Doors of this type may sometimes be steel lined with wooden facings so that the steel work is concealed until the door has been attacked. If such a door must be forced, attack on the hinge side will probably yield the best results. Steel doors are sometimes fitted with a cast-iron plate close to the lock, so that the plate can be broken and the hand inserted to release the fastenings on the far side.

With certain types of steel-covered door it may be possible, if

no other means of entry is available, to cut away a section of plating with an oxy-acetylene cutting set.

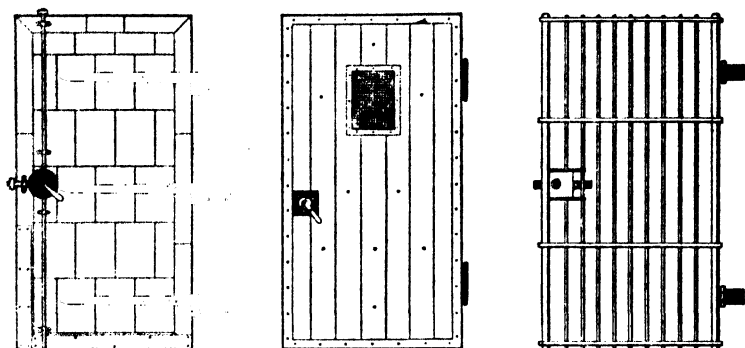


Fig. 4. Sketches showing typical metal doors. Left and centre : two types of steel-covered fire-resisting door. Right : barred door.

(v) *Barred*. Barred doors vary greatly in construction but a typical example is shown in Fig. 4 (*right*). If the bars are of relatively light construction, it may be possible to cut a sufficient number to give an opening, using heavy bolt cutters or shears or, if this is impossible, a hacksaw. Alternatively, an oxy-acetylene cutting set might be employed, or it may occasionally be possible, using a heavy car-type jack, to force the bars sufficiently apart. If the bars are heavy, however, all other entrances should be tried before effort is directed toward them.

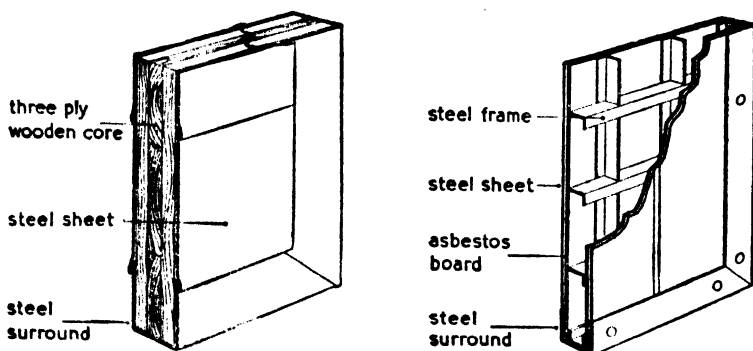


Fig. 5. Diagrams showing two types of steel fire-resisting door. Left : steel-covered on wooden core. Right : steel-covered on steel frame lined with asbestos.

(b) *Swing Doors*. Doors of any of the above types may be found with special pin hinges (Fig. 6) allowing them to swing in either direction and consequently there is no rebate on the jamb. Such doors may consist of a single leaf or a double leaf in a single opening.

Swing doors are frequently used in restaurants and hotels, and also on staircases and in long corridors to check the spread of smoke in case of fire. They are often partly glazed, the glass being wired or set in copper glazing bars in those cases where some degree of fire resistance is desired. If solid, they frequently have a glass panel, and are generally of flush construction.

Single leaf swing doors are normally secured by mortice locks, bolts, or padlocks with hasp and staple in the same way as a normal door. They may, however, occasionally be found secured with drop or swing bars. Double leaf swing doors are usually locked by a bolt on one leaf, which is fastened first, and a mortice or other lock on the second leaf to secure it to the bolted leaf. If the lock is on the nearside it may be dealt with as described later; if the lock is of the mortice type, or on the far side, and no glass panel is fitted, the door must be cut away sufficiently for the fireman to reach the bolt, or, if necessary, to crawl through. The half of the door containing the lock should be attacked if it can be identified. (This will usually be indicated by the keyhole.)

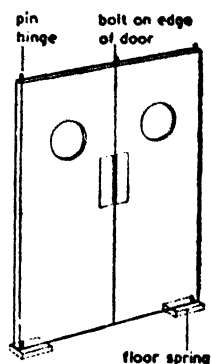


Fig. 6. Self-closing type double swing door showing pin hinge, bolts and absence of rebate. Note the panel of fire-resisting glass.

(c) **Revolving Doors.** Revolving doors present an obstruction to the fireman since, unless they are first collapsed or broken in, they do not permit the passage of any bulky object or lines of hose, etc. These doors revolve on central pivots at the top and bottom and usually have four wings arranged at right angles to one another. In some types of door only two wings may be found, each of which has a curved extension piece.

These doors are rarely locked, but may become jammed. They are, almost invariably, fitted with glass panels in their upper parts, and if the catch cannot be released from outside (see later) preliminary entrance may be obtained by breaking the glass and climbing in. The wings on the doors are, in most cases, constructed to collapse and move to one side so as to give a relatively unobstructed opening. Two methods of securing the wings are generally employed and are illustrated in Fig. 7.

(i) In the first of these (Fig. 7, left) the wings are held in place

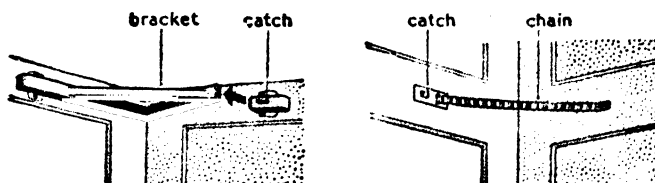


Fig. 7. Sketch showing two methods of securing the wings of revolving doors. Left: stretcher bar type. Right: chain type.

by a bracket or solid stretcher bar situated usually at the top of the door across the angle formed by the leaves where they join the newel post. One end of each bar is permanently connected to one leaf of the door and the other end engages with some form of catch on the adjacent leaf. The wings are collapsed by releasing the stretcher bars either by undoing the wing nuts or unfastening the catches which hold them in place.

(ii) In the second type (Fig. 7, *right*), the two opposing wings are hinged to the single leaf formed by the other two and kept in position by a chain which runs through them and which is held by

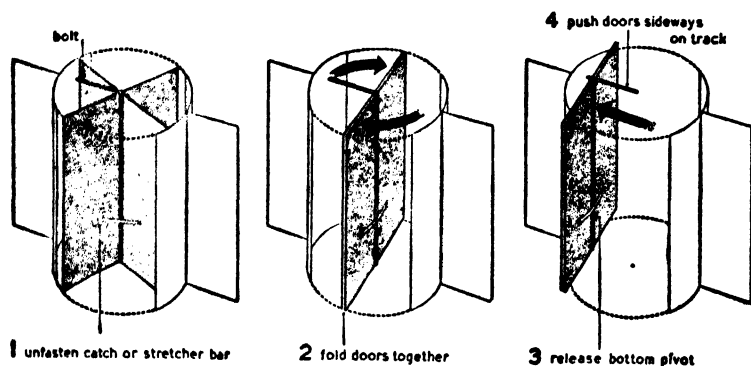


Fig. 8. Diagrams showing one method of collapsing a revolving door.

a catch on each of the hinged leaves. If this catch is released, the wings can be folded back to give a clear opening. This operation is shown diagrammatically in Fig. 8.

(iii) Both types of door may also be constructed so that after the wings have been collapsed the whole door may be slid bodily sideways to give a clear opening. This is effected by releasing a catch fixed close to the newel post in one of the compartments and pushing sideways (Fig. 8, *right*). A track, either in the floor or ceiling, will indicate whether the door slides to left or right.

(d) *Sliding Doors*. These doors may be of either solid construction or in the form of a lattice which collapses into a relatively small space when opened.

(i) *Solid Type*. Sliding doors may run in tracks above and beneath the door (Fig. 9) or be suspended from an overhead track (Fig. 11). They are not often encountered in domestic property, except possibly in garages, but are widely used in com-

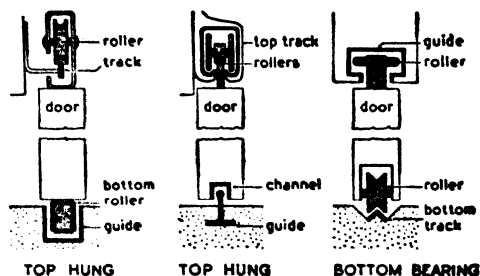


Fig. 9. Diagrams showing typical sliding door tracks.

mercial premises, especially as fire-resisting doors for isolating sections of a building. These doors may either slide on one or both sides of the opening or may alternatively move into a central recess in the wall. Some of the more common arrangements are shown in Fig. 10. They may not always immediately be identifiable as being of the sliding pattern, but the design of the handle, which is constructed to give a purchase for a sideways pull, and the recess in the side to which the door slides, may be clues.

If the fastenings are accessible, they should be dealt with as described below, otherwise sliding doors should normally be attacked by levering them with a crowbar away from the jamb on the side from which they would move. Doors of this type should not be struck violently, since if they are distorted they cannot slide into the recess which may be provided for them. Alternatively, depending on the type of rail on which they run, such doors may be lifted off the top rail (Fig. 11) by levering them upwards with a couple of crowbars (Fig. 12). They will then come off the tracks and fall away from the wall.

In large premises sliding doors will be found in pairs, with halves sliding toward the centre, which may be locked to one another either on the inside or the outside. The most usual method of securing them is by a substantial hook and eye, drop bar, or hasp and staple. Pairs of doors can usually be parted sufficiently by driving the blade of an axe between them to see what sort of fastening is employed. The blade of an axe or of a flat spade knocked

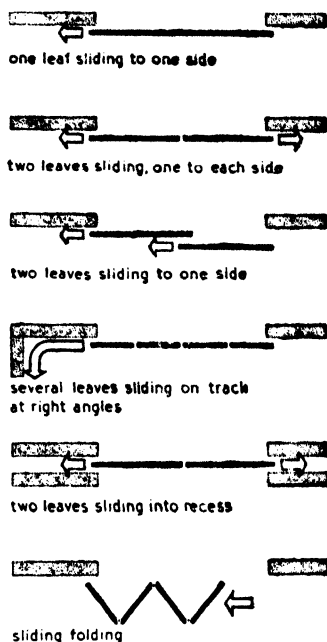


Fig. 10. Diagrams showing plans of principal types of sliding door.

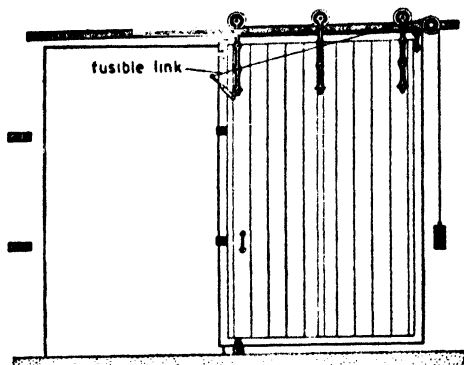


Fig. 11. Diagram showing one type of sliding fire door running on an overhead track and operated by a fusible link.

upwards will usually dislodge a drop bar, but it may only be possible to deal with a hasp and staple by cutting away part of the door

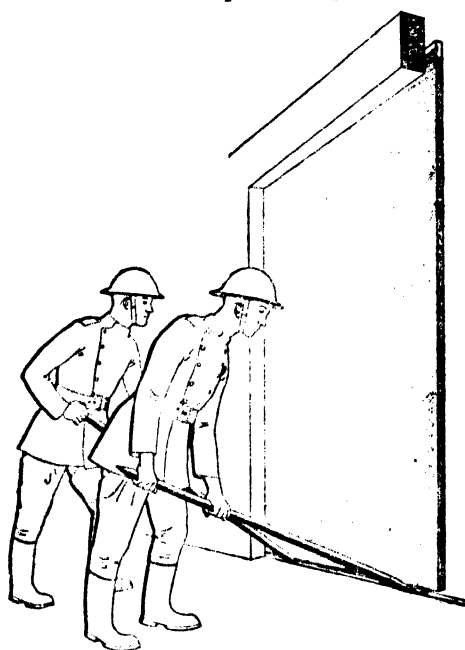


Fig. 12. Sketch showing method of lifting a sliding door off its track by the use of crowbars.

not be violently attacked. Instead, an effort should be made to force the lock, and careful examination will show how this may best be done. Gates of this type used on lifts have an automatic locking device which is usually at the top but may sometimes be

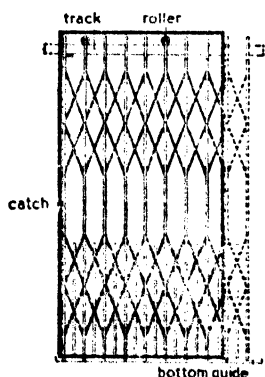


Fig. 13. Typical steel lattice gate.

close to where it is believed to be and then dealing with it through the hole so made. It should be remembered that ordinarily, when looking at a twin leaf sliding door *from the side on which it is fastened*, the padlock is on the right-hand leaf and consequently is on the left-hand leaf when approached from the other side.

(ii) *Steel Lattice Type.* This type (Fig. 13) is widely used to protect property where weatherproofness is unimportant. The gate usually runs on two sets of tracks, one above and one beneath, but may sometimes be found with a bottom track only. Since any distortion of the steelwork may result in jamming, it should

not be violently attacked. Instead, an effort should be made to force the lock, and careful examination will show how this may best be done. Gates of this type used on lifts have an automatic locking device which is usually at the top but may sometimes be incorporated in the latch. This lock must, of course, be freed, in addition to any manual locking device, before the gate can be opened. Alternatively, it may be possible to cut away suitable parts of the gate with a hack-saw or oxy-acetylene cutting set.

(e) *Folding Doors.* Folding doors are usually of fairly light construction and will often give way to a vigorous push with the shoulder. Exceptionally, they may be very large and of robust construction, in which case the only course will be to endeavour to force the lock if this can be found, or, in the case of a door with panelled construction, to cut away a panel and obtain access to the inside. In certain types of folding door, bolts will be found

on each leaf and all must be freed before the door can be fully opened.

(f) Cantilever Doors.

In this type (Fig. 14) the door is counterbalanced and pivoted so that the whole door rises upwards and, when open, lies horizontally. The fastening must first be parted, after which the door can be opened by lifting upwards and outwards. Steel-plated doors of this type are sometimes found in boiler houses in which Lancashire boilers are installed. These doors often fit flush in the opening and there is generally no obvious indication of the method of opening.

(g) Roller Shutters.

Roller shutters are nearly always made of steel but may sometimes be found of wood. Those of steel are very difficult to deal with and alternative means of entry should always be looked for before any attempt is made to break through such a shutter. If there is no external locking device this usually indicates that there is an alternative entrance, which should first be sought.

Small types up to about 8 ft. by 6 ft. are generally raised by a direct lift with the hands, but the larger sizes are almost invariably operated by means of gearing (Fig. 15) and some form of handle or chain block on the inside. Very occasionally, shutters fitted with chain gearing may have a cast-iron panel, installed in the brickwork close to the chain, which can be broken and through which the hand can be inserted from the outside to operate the chain. Roller shutters secured from the outside will usually be fastened with a lock or padlock which can be dealt with as described later. When the shutter is fastened from the inside, the bottom end is often

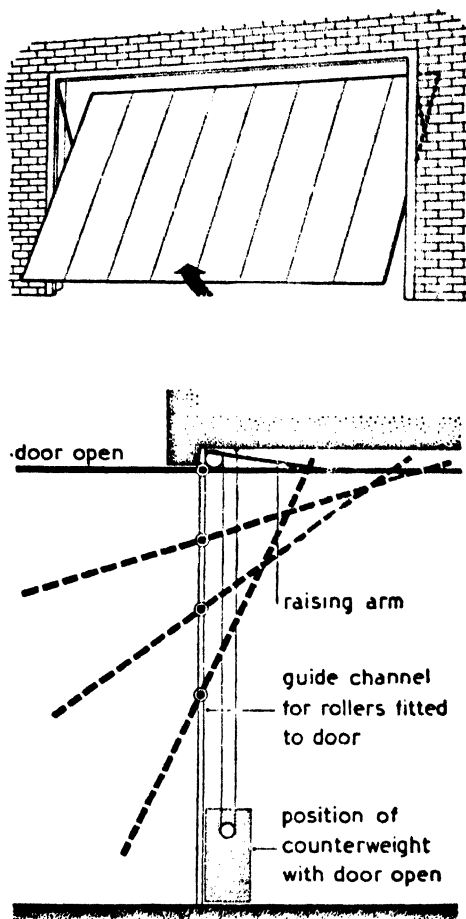


Fig. 14. Typical cantilever door.

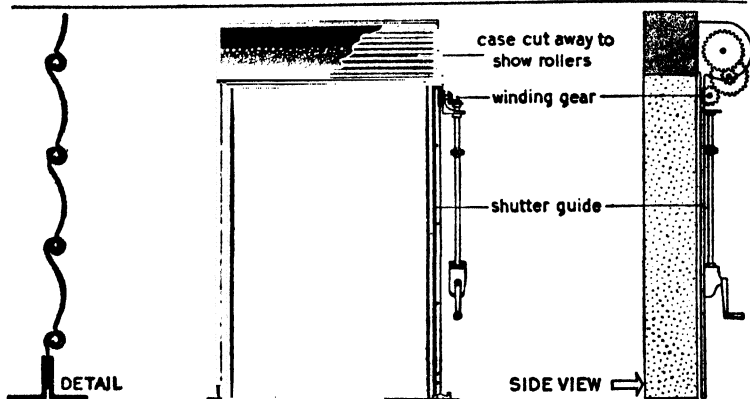


Fig. 15. Diagrams showing typical gear-operated roller shutter, with (left) detail showing section of shutter.

secured by a bolt the head of which protrudes on the outside, in which case the head may be struck off with a cold chisel, and the bolt pushed through the hole to free the catch. It will sometimes be found, however, that the head of this bolt is flush set into the bracket and cannot be struck off in this way. Two crowbars inserted under the bottom edge may lever the shutter up sufficiently to part the lock. The crowbars should be inserted one on either side of the fastening and the leverage applied equally. Care must always be used, however, for should the shutter be distorted by violence it will prove impossible to open.

On some types of roller shutter (more usually those of wood) it may be possible to lever one end out of the guides and pull out sections until an opening of sufficient size has been made. A hole of suitable size may, of course, be cut in steel shutters with the oxy-acetylene set, if available. If the shutter has been opened and men are working on the far side, it must always be wedged open so that it cannot fall and trap them.

2. METHODS OF SECURING DOORS

Doors and gates will ordinarily be found secured by any one or a combination of the following methods:

- a lock either of the mortice or rim type (Fig. 16);
- a padlock used with hasp and staple;
- bolts which may be screw on or "blind";
- a swing or drop bar;
- panic bolts.

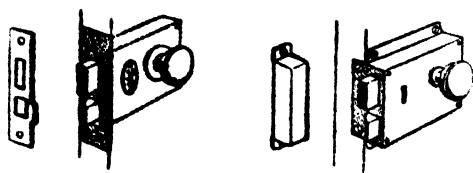


Fig. 16. Sketches showing (left) mortice and (right) rim locks.

(a) Mortice Locks.

A mortice lock is one which is let into the edge of the door so that when viewed from either side only the keyhole is visible.

One of the fol-

lowing methods of forcing a door fastened with a mortice lock may be successful, according to the construction of the door and the way it opens. Certain of these methods will also apply to doors fitted with rim locks (see below).

(i) The bolt of the lock may be prised out of the lock plate by using a large axe in conjunction with a heavy wedge. The wedge is driven between the door and the jamb, using the back of the axe as a sledge hammer, and the bolt of the lock forced out of the lock plate by leverage. Alternatively, for doors opening toward the operator, the blade of a large axe may be driven in between the door and the jamb either just above or just below the lock. If the handle of the axe is then levered toward the wall, away from the door, the latter will be prised out of its fastenings.

(ii) The solid portion of the door beneath the lock can be attacked with the head of a large axe.

(iii) If it is believed that the key is in the lock on the far side and if the door is of wood or is part glazed, the panel beneath the lock can be cut away or the glazing can be broken so that a hand can be inserted to turn the key from the inside.

(iv) The lock may be cut out entirely by removing the woodwork round it. This method is especially suitable on the lighter types of framed door.

(v) The lock may be forced with one of the special patterns of lock opener found among the equipment of certain appliances, or (when the door opens away from the operator) by the use of a door breaker, as described in Part 1, p. 231.

(vi) In the case of double swing doors which have no rebate, a hacksaw blade can sometimes be inserted in the gap between the two leaves and the bolt of the lock (which is usually of brass) cut off.

(b) *Rim Locks.* These are usually of relatively light construction and work into a screwed-on lock plate on the door jamb. If the lock is on the near side it will present no difficulty, for even if the key is missing the lock plate can be prised off or (if time permits) unscrewed. If the lock is on the far side, a sharp blow will either spring the lock or knock off the lock plate, with very little damage to the woodwork. Another useful method of forcing a rim lock is to drive a tapered wedge under the door with the back of an axe, thereby raising the door slightly and straining the screws securing the lock plate. A sharp blow with the flat of a heavy axe near the lock will then usually force the door.

(c) *Padlocks.* There are various ways of removing a padlock.

(i) By the use of a padlock remover, persuader (Part 1, p. 232) or similar device.

(ii) By using a bolt-cutter or hacksaw to sever either the hasp of the padlock or the staple through which it is secured.

(iii) By wedging the hasp of the lock against the door with its hinge downwards and giving the body of the lock a sharp blow with a hammer or the flat of a large axe (Fig. 17, right).

(iv) By inserting the point of a fireman's axe in the loop formed by

the hasp of the padlock and twisting the whole until it comes away (Fig. 17, *left*).

(v) By knocking off with an axe the hasp and staples or, if the fastening is on the far side, the heads of the bolts securing them, the bolts then being pushed through the hole so that they fall through and release the catch.

(vi) By inserting the point of a crowbar into the loop formed by the hasp of the padlock, holding the other end and then striking the crowbar sharply close to the padlock (Fig. 17, *centre*). This will often spring the lock and cause it to fly open.

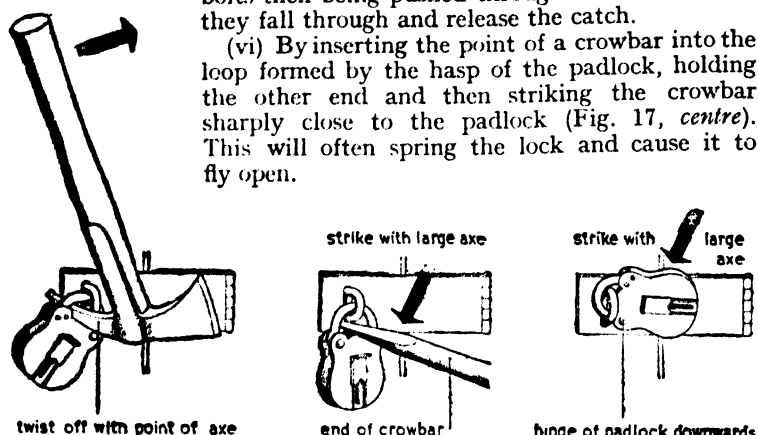


Fig. 17. Sketches showing three methods of breaking open a padlock without special tools.

(vii) In some types the hasp is hinged on a pin which goes through the body of the padlock and is riveted externally at both ends. Filing off the rivet head on one side and driving the pin out would release the hasp without causing damage except to the lock.

(d) **Bolts.** Bolts vary greatly in strength of construction. They may be fitted either to the centre or to both top and bottom of a door, on the face of the door or (where appearance is important) on the edge of one leaf of a double swing door.

(i) When the position of a bolt on the far side of a door is known and the socket with which it engages is lightly secured, the latter may be knocked off by a sharp blow from the back of an axe on the door immediately opposite the bolt.

(ii) If a bolt is on the far side and the heads of the fastenings securing it project through the door, they may be knocked off with a cold chisel or axe.

(iii) If the bolt cannot be released by either of the above methods a hole may be cut in the door through which the hand can be inserted to undo it.

One leaf of double swing doors is often fitted with bolts on the edge, and these cannot be reached until the other leaf is first opened.

What are often known as blind bolts may also be found (often in hotel bedrooms and in private houses) as a protection against burglars, since they cannot be detected from the far side. In this case, if it is impossible to cut a hole in the door to allow the hand to reach the bolt, it will be preferable to attack the door from the hinge side.

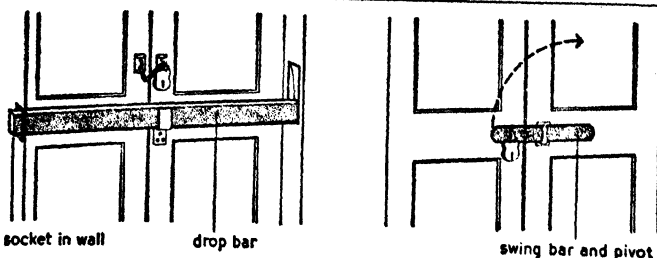


Fig. 18. Sketches showing common types of drop bar. Left : removable type. Right : swing type.

(e) *Swing or Drop Bars.* Drop bars (Fig. 18) are often used to secure double leaf doors. They can sometimes be removed, if the doors can be sprung sufficiently to get an axe blade or a spade between, by knocking up the axe blade to dislodge the bar. On the other hand, the swing bar which is pivoted on one leaf and which drops into a socket and then folds over a hasp and is secured with a padlock, may be virtually impossible to attack from the far side unless part of the door is cut away so that the fastenings can be reached.

(f) *Panic Bolts.* If the doors are not fitted with a rebate it should be possible to spring the two leaves apart sufficiently to get the blade of a long, stout knife, or other similar thin but rigid object, between them. The blade of a fairly flat spade (Fig. 19, *inset*) may serve the purpose. If this is then knocked up it will force the crossbar of the panic bolt upwards and release the catches, enabling the door to be opened. It will be remembered that doors fitted with panic bolts always open outwards, away from the side on which the bolts are fitted.

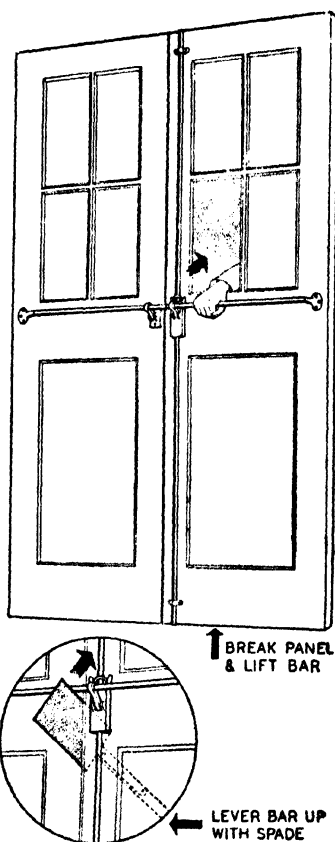


Fig. 19. Sketch showing normal method of forcing panic bolts with (inset) alternative method which can be employed if no rebate is fitted.

If it is impossible to get a suitable object between the leaves in this way, a hole should be cut in a panel *above* the bolt and the hand inserted to lift the bar (Fig. 19). It will be found that in some premises the two leaves of the door are secured with a chain and padlock once all members of the public have left, and either these will have to be forced, or an alternative means of entry sought.

3. HINGES

In some cases, as, for example, when the front door of a house is secured by two bolts, top and bottom, two locks, rim and mortice, and a chain, the hinge of a door may be the best part to attack. Some doors, especially those in stables and farm buildings, are hung on strap hinges with pins on the doorposts and can be lifted off the hinges without damage. One of the following methods of attacking the hinge may be applicable:—

(i) With certain types of hinge it may be possible to remove the pin by inserting the axe blade underneath the head of the pin

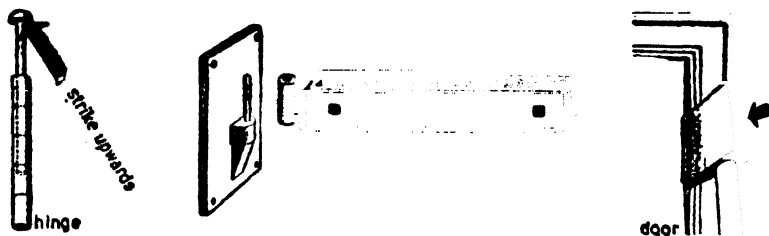


Fig. 20. Sketches showing methods of forcing doors on the hinge side. Left : pin hinge. Centre : strap hinge showing strap lifted off pin. Right : prising door away from hinge.

and then twisting it, or knocking it upwards (Fig. 20, *left*), so as to free the pin, which is then withdrawn from the top.

(ii) If the hinges cannot be seen, and the lock cannot be forced, or bolts drawn, the door may be driven in by heavy blows with the back of an axe against the points where the hinges are likely to be.

(iii) Swing doors are sometimes swung on two pin pivots which project into a recess in the floor and in the lintel above. Such pivots are often made of cast iron and a sharp blow with the back of an axe at the two extremities of the door close to the hinges will snap them off, and the door can be removed. In some types it may be possible to lever the door up sufficiently on the hinge side to release the pin of the hinge and allow the door to open.

(iv) In the case of doors swung on strap hinges with pins on the door posts, it may often be possible to spring the top of the door out of the rebate and lever up the door from the bottom, lifting the straps off the pins and thus freeing the door without structural damage of any sort. This often applies also in the case of heavy gates (Fig. 20, *centre*) used to close the entrances to yards of industrial premises, and to farm gates when these are kept locked.

(v) When the hinges can be seen (Fig. 20, *right*), the blade of an axe should be inserted between the door and the hinge plate and the

back of the axe struck, so that the blade severs the screws holding the hinge.

4. FANLIGHTS

It may often be possible to avoid the necessity for breaking in a front door by getting in through the fanlight which is often fitted above it in private houses or lock-up shop property. If the light is open, the guides on either side should be forced apart so that the fanlight can drop down and leave a clear opening through which to crawl. If the fanlight is carefully lowered the glass need not be broken. If the catch cannot be released from the outside without breaking the glass, it will still be desirable, after releasing the catch, to lower the light to enlarge the opening through which to crawl, and to avoid the necessity for having to clear away all glass, etc. If the fanlight is of the fixed type then the glass should be broken and cleared away completely, to avoid risk of injury.

In either case, having made the opening, the fireman should enter feet first, face downwards and drop down inside in the same way as when lowering himself from a window (see p. 149). Having entered the premises, the door can usually be opened from the inside without damage.

5. WINDOWS

The initial survey will have shown whether any windows on the face of the building are open at ground or higher levels, and if so it will usually be found quicker and far less destructive to pitch a ladder and gain access in this way than by breaking open a door. Ordinary window glass is far cheaper and easier to replace than woodwork, and this method of entry should always be considered even though a window is not found open. This applies particularly if the door is solid and obviously valuable.

When selecting the window, one above the front door should preferably be chosen. This may lead direct on to the staircase or a landing, but if not there will almost invariably be opposite the window, a door leading out of the room on to the stairs. It is then possible, if the fire situation permits, to proceed down the stairs to the front or side door and unlock the door from the inside. Great care should be taken, when entering through a window above the ground floor, to ensure that it gives access to a room and not to a stairwell or other drop. Windows are often provided in such places for lighting or ventilation, and a fireman entering incautiously might suffer serious injury.

Whatever the type of window, if it is necessary to break the glass, the jagged edges should be cleared from around the frame, to prevent injury to men as they enter and to equipment, such as hose lines, which may later be taken in. It will often be advisable to use a piece of old sacking, door mat, etc., to form a saddle to give protection.

(a) *Plate Glass Windows.* Plate glass windows used in shops, depending on their size, may be extremely costly, and every alternative should be explored before it is decided that such a window

should be broken. This course should never be adopted to gain entry except in cases of emergency where life is at stake, or where it is obvious that the window would become involved in the fire and

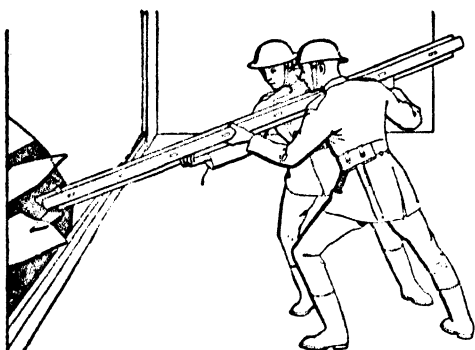


Fig. 21. Sketch showing method of using a ladder as a battering ram to break a plate glass window.

to the doorway of the shop and these should be chosen for preference.

To break a plate glass window, a ladder may be used as a battering ram, but care must be taken to see that the end of the ladder which strikes the glass is lower than the other end (Fig. 21), so that the broken pieces slide away from the operators.

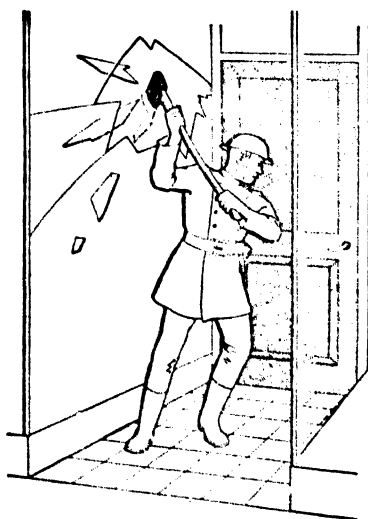


Fig. 22. Sketch showing the danger of careless use of an axe when there are flanking plate glass windows on either side of an entry.

would in any event suffer damage. It may, however, be necessary to collapse such a window where it would form a danger to those working in the vicinity, *e.g.*, when it is severely cracked. When a plate glass window must be broken, the smallest section of glass should be attacked. There are often small windows flanking the entrance may be pitched alongside, with the head supported above the window, which should then be broken near the top, using the flat of an axe. The remaining members of the crew should stand well clear of the falling glass. A ceiling hook may also be useful for pushing in a window. It should be remembered that in some jewellers' premises shutters are set behind the window and arranged to fall if the window is broken, thereby delaying entry.

In many shop premises the door is set well back from the frontage, the way to it being flanked by plate glass windows (Fig. 22). Great care must be taken, therefore, when working on the door not to strike these flank windows accidentally with the tools being used to gain access through the door. When

endeavouring to open a door in shop premises fitted with large plate glass windows held in light metal frames, care should be taken to guard against endeavours to open the door distorting the framing or breaking the window. Certain other windows, such as curved non-reflecting types used in shops, and bow or engraved windows used for decorative purposes, may also be very valuable and should only be broken when all other means of entry have failed. An important point to bear in mind when considering whether to break a plate glass window is that the large opening thus created may vent the fire enormously and result in a very rapid spread.

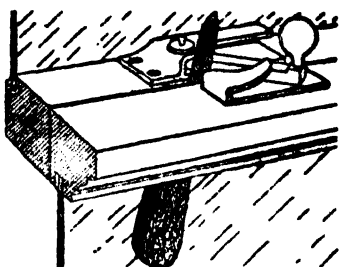


Fig. 23. Sketch showing method of opening a sash window by slipping back the catch with a knife.

(b) *Sash Windows.* The frames of sash-type windows are almost invariably made of wood. On these windows it may often be possible to slip back the catch from the outside using a knife (Fig. 23) or the blade of an axe, and thus avoid the necessity for breaking the glass. When this cannot be done, the pane of glass opposite the catch should be broken and the axe used to unfasten the catch. If this is impossible, the catch should be released by hand, but whichever method is used it is essential to hold the upper sash with the free hand (Fig. 24), to prevent it falling should the sash cords be broken. Sash-type windows will also be found in which the lower window rises and falls normally whilst the upper window is pivoted about a horizontal axis and swings open in the same way as the factory type described later. When breaking a pane of glass, the flat of the small axe should be used to give a sharp but not hard blow. The glass will be driven into the room and will not then fall on those working below. The hand should be kept *above* the head of the axe (Fig. 25) to prevent any pieces of glass slipping along the handle and causing cuts. A further point in connection with the breaking of windows, is to take care when stepping inside to avoid slipping on the broken glass. This should be pushed to one side out of the way, immediately the window has been entered.



Fig. 24. Sketch showing method of opening sash-type window when pane has been broken. Note left hand holding upper sash to prevent it falling and that all jagged edges of glass have been removed from the glazing bars.

In certain buildings such as mental hospitals it may be found that sash windows are constructed to open only a short dis-

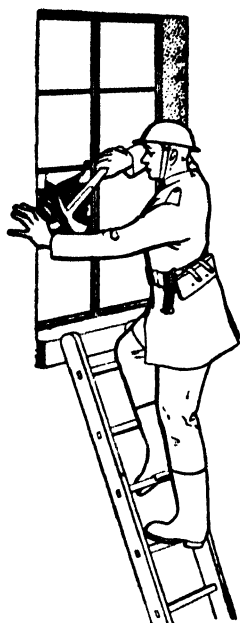


Fig. 25. Sketch showing method of breaking a pane with an axe to effect entry to casement type window. Note that the head of the ladder only reaches to the sill.

tance, whilst in private houses, stops sometimes known as "acorns," may be found screwed into the upper sash at the sides so as to prevent the lower half of the window from being opened more than a few inches. These "acorns," however, can be unscrewed if access is gained by breaking the glass. It may also be found that sash windows originally constructed to open, have become stuck through being painted up, etc. In such a case the blade of an axe should be inserted at the bottom and the window prised up.

Once the fireman is inside, if a person must be got out of the building it will often be quicker, particularly in the case of a small window, to remove the entire window frame rather than break it up. To do this the wooden beads, one on either side, should be removed by prising them away with an axe blade; the two sash cords should then be cut with the axe and the entire window lifted out. If necessary, both frames can be removed in this way to give a clear opening the full size of the window.

(c) *Casement Windows.* Both wood and steel are widely employed for the frames of casement windows. It is usually impossible to release the catch from outside, so that it is necessary to break the pane of glass nearest to, but below, the catch. The locking bar which is generally fitted to these windows can then be released through the same hole. It should be remembered that casement windows almost invariably open outwards (Fig. 26 (i)), so that when pitching a ladder to the window, the strings should not project over the sill (Fig. 25). It will be obvious from street level whether a window is a sash or casement type. In the case of a double leaf casement window the ladder should be pitched to the *catch* side if it can be seen from ground level, for that will be the one that opens.

(d) *Factory Windows.* Steel framed windows, particularly those of relatively large size in commercial premises, may be found arranged to pivot about a horizontal axis, the upper part usually opening inwards and the lower part outwards (Fig. 26 (ii)). The catch may be fitted either at the top or the bottom but more usually the former. Alternatively, a vertical axis may be employed (Fig. 26 (v)). It should be a simple matter to break the glass close to the catch, which usually has a finger grip and spring, and thus release the window. If for any reason this is impossible, a crowbar placed between the fixed portion and the open portion may be

sufficient to spring the pivots, providing the glazing bars are not horizontal. Factory type windows are often secured by thumb screws at the top of the top half and bottom of the bottom half. These screw into the frame and must be undone before the window can be swung open or before the frame will come away.

○ denotes usual position of catch

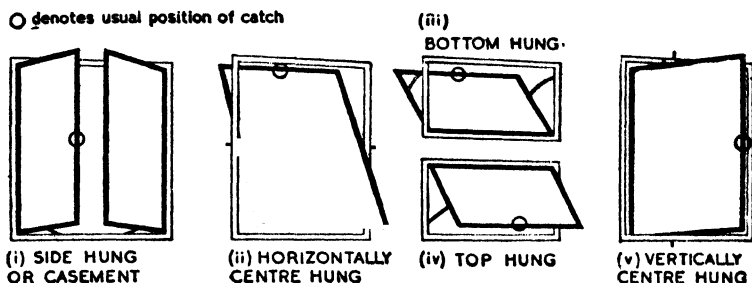


Fig. 26. Diagrams showing common types of window opening.

The second type of opening in factory windows may be bottom hung, to open inwards from the top (Fig. 26 (iii)), or top hung to open from the bottom (Fig. 26 (iv)), fastened as in the first type usually by a spring catch. Entry through this type can be made by breaking the glass, releasing the spring catch and then releasing or striking off the chain or quadrants which control the depth of opening of the vent. If this type of window is operated by gearing (Fig. 33, right) it will be necessary to release the gear on the horizontal shaft by means of a spanner.

Similar to the bottom hung window is the hopper window, which is not hung on hinges but in which two pins engage in guides in the side members. After releasing the catch, the window may be lifted out of the guides, thus leaving the whole opening clear.

(e) **Fixed Windows.** Such windows may either have been originally constructed not to open or subsequently screwed up or otherwise rendered inoperative. When of wood, the necessary panes of glass to form the size of opening which is required for entrance should first be broken, and the glazing bars should then be cut away. If of metal, they may present a serious problem, but after breaking the glass it may be possible, with the back of a large axe, to break sufficient glazing bars away from the framework to make an opening.

(f) **French Windows.** These can be treated either as a panel door or a casement window as appropriate.

(g) **Barred Windows.** Bars will present a serious problem. If of very light gauge, such as are used for nursery windows, they may only be nailed or screwed into place and may be knocked out or prised away with an axe. If of rather larger size they may be sheared with bolt cutters or shears, or, if time permits, cut with a hacksaw. If, however, they are of substantial size, such as are used to protect the lower floors of warehouses or basements, the probability is that they will be set into the brickwork or stonework. No

attempt should be made to cut them except with an oxy-acetylene cutting set, if one is immediately available. They should be freed either by bending the bars with blows from an axe and so causing a relative shortening, which pulls them away from the stonework

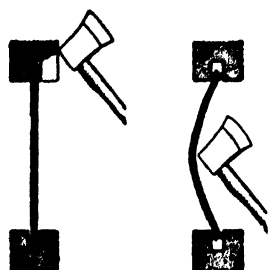


Fig. 27. Diagrams showing methods of forcing a barred window. Left: by hacking away stonework. Right: by bending the bars.

(Fig. 27, right), or by breaking away the stone or brickwork into which they are fastened (Fig. 27, left) and then pulling them clear. The stone can be flaked away by blows from a pick or the pick end of the small axe, or by striking it on the edge with the back of the large axe, or with a sledge if available. The bars can then easily be pulled sufficiently clear to allow of entry. Alternatively, the bars may be forced apart by means of a vehicle jack. Since these windows are often not glazed there may be an inner screen of wire netting, to prevent the entry of birds, etc., which will have to be cut away after the bars have been removed.

If the bars are close to a road where vehicles can operate it may be possible to secure a wire strop to the towing eye and pull the bars out of place by driving the vehicle away in low gear. When using a strop to pull out a bar in this way, there is danger from the whipping ends if the strop should break. Men should be warned to stand clear and should not be at work on branches in the immediate vicinity.

(h) **Leaded Windows.** Leaded windows, which consist of a number of small panes of glass held together by strip lead, can sometimes be cut away as a single panel and placed to one side. The lead is usually sufficiently soft to cut with a penknife, but may sometimes be reinforced with steel strip, although it is even then still possible to lift the lead beading and free the glass. Such windows, if of coloured glass, may often be of considerable value, and it is therefore preferable to take out the whole panel, by running a knife or blade of an axe round the outer edge, rather than to remove a small section. If this is impossible, a small section should be prised out with all possible care. The value of stained glass windows lies in the glass, and not the leading, which can be replaced. The leaded panes are very often held in position by light gauge bars, running from side to side of the opening. These bars will also have to be removed.

(i) **Double Windows.** Double windows will be found in certain types of premises such as hotels, nursing homes and offices, where they are installed for sound proofing. In this case the outer window only is usually securely fastened, the inner having, in most cases, a very flimsy method of keeping it shut. Certain windows in old-fashioned houses may be found with wooden folding shutters inside; these are usually secured with a flimsy hook and eye but occasionally may be found secured with a drop bar.

6. OTHER OPENINGS AT GROUND LEVEL

In addition to doors and windows, other openings may be available at ground level through which entry can be forced if necessary, as for example when attacking a basement fire. Amongst these are gratings; pavement and stallboard lights; cellar flaps and chutes for coal or other commodities.

(a) *Gratings.* Basement windows may often be protected by gratings on the pavement. These gratings are often made to lift up without damage or may be set (usually with lead) into the paving stones. A sharp blow with the back of an axe close to the point where the grating is set will usually free it sufficiently to permit it to be pulled clear. In the case of a removable grating, which may be held down to an eyebolt by a central chain at the bottom of the area which it serves, it may be possible to lever the grating up and displace it sufficiently to gain access. Alternatively, the bars may be cut through with an oxy-acetylene cutting set, if one can be obtained. A self-locking burglar-proof type of grating is sometimes found.

(b) *Pavement and Stallboard Lights.* Basements in which goods are stored are often fitted with pavement lights or stallboard lights (Fig. 28). Pavement lights are horizontal and are sufficiently strong to allow pedestrians to walk over them. They may be constructed solely for lighting or to open either for ventilation or for the loading of goods, in which case they may be placed in the same class as cellar flaps. Pavement lights (Fig. 29) are constructed of thick glass panels, often prismatic in shape, set in metal or concrete frames. Lights which can be opened from the inside very

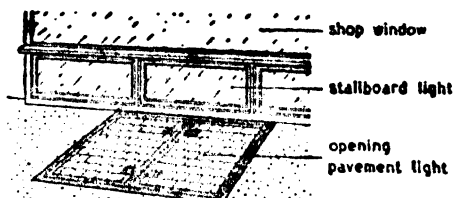


Fig. 28. Sketch showing typical pavement and stallboard light construction.

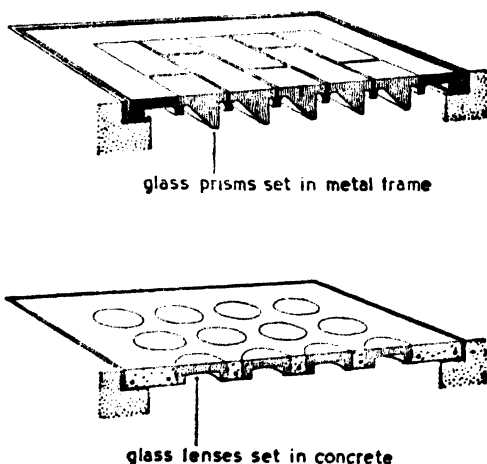


Fig. 29. Sketch showing two principal types of pavement light construction. Above: glass prisms in metal frame. Below: glass lenses set in concrete.

often have breakable glass panels set near the catches. Sometimes these panels are identifiable by being made of glass of a different colour. To enter, they should be broken with, say, the back of an axe, the hand inserted and the catch released. As goods lifts or hoists are sometimes found beneath such frames, care should be taken on entry. Types which are not hinged may sometimes be prised up out of their settings with the chisel end of a crowbar, but this is usually very difficult, for such lights are heavy and are often fixed in position either with bitumen or cement grout. Stallboard lights are similar to a vertical steel window set well down below a shop window, but are seldom of such strong construction as pavement lights, since it is only necessary for them to resist accidental knocks from passers-by. As they resemble a window they can be dealt with as such.

(c) **Cellar Flaps.** Many premises in which the basement is used for storage have trapdoors, known as cellar flaps (Fig. 30) opening

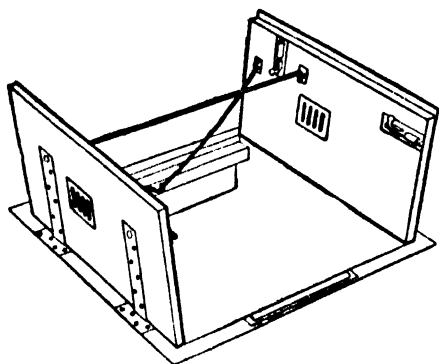


Fig. 30. Sketch showing construction of typical cellar flap.

on to the pavement. The doors covering these openings are lifted up when it is desired to load or unload goods and are usually arranged so that a staybar or wire mesh grid, which also often serves to protect the opening, holds them in place. They are often of wood and may then be forced by removing one of the boards to gain access to the fastenings below. Considerable care should be exercised in using this type of entrance,

however, as lifts or hoists often operate below the doors and might fall when weight is applied to them by pitching a ladde down them.

(d) **Chutes.** The size and construction of chutes varies greatly. Some will permit the passage of a fireman but others may prove too small. Iron covers which can be lifted up are used for the smaller types, but trapdoors fastened in a variety of ways will be found in the larger sizes. They will, however, normally open upwards or outwards. If it is necessary for a man to enter premises *via* a chute, consideration should be given to the desirability of attaching a line to him to ensure his safety should the end of the chute be sealed off or otherwise dangerous.

When a pavement light, cellar flap, or chute, etc., has been opened up, a man should be posted by it in order to warn passers of the obstruction, or, alternatively, it should be adequately guarded to prevent injury to the public or the crew through falling into it. At night it will be desirable to place a light by the side as a warning.

7. OTHER OPENINGS ABOVE GROUND LEVEL

When determining the most suitable method of forcing an entry after the more obvious courses have failed, it should never be overlooked that this will in all probability be much more easily achieved above ground level. Windows on upper floors are frequently left open by private householders, and in larger buildings staircases more often than not open on to the roof, and such doors, even if not left unfastened, are usually fairly readily opened.

Where access to a building must be obtained above street level, two methods are possible, first, the use of ladders in their various forms, and second, access from adjoining property. The correct handling of ladders has already been dealt with in Chapters 6, 16 and 17. When a long climb with hook ladders is necessary, the ladders should be carried as far as possible up the stairs, or the stairs of the premises adjoining should be used, and the climb started from the highest practicable point. Alternatively, it may be possible to reach the roof or a window on a floor above and descend by hook ladder to the required level.

When seeking an entrance at upper levels the possibilities of utilising a dormer window or door on to a flat roof or verandah should not be overlooked. Dormer windows are frequently associated with wide parapets and access may be gained from adjoining property. Skylights may sometimes be broken open or lifted off and the short extension ladder or scaling ladders used to reach the inside of the building. Many properties, particularly those of old construction, have a common roof space, and it may be possible to obtain access from adjoining premises *via* the trapdoors which are often provided. It should not be forgotten that skylights very often open direct on to a stairwell and that there may be a considerable drop.

(a) **Loopholes.** Loopholes (Fig. 31) are loading doors on upper levels from which goods are loaded or unloaded by a crane or pulley block mounted usually on the building itself. In commercial premises loopholes on upper floors sometimes offer a relatively easy way in, but at other floors may be secured on the inside by heavy drop bars which may be extremely difficult to displace. They are often fitted with an external drop platform, which in some cases can only be lowered by releasing the chains from inside the premises. In this type it is extremely difficult to pitch a ladder in such a way that the platform as it is lowered will not foul it. One or other of the methods already described for opening doors will be used, depending on the construction found near the loophole is closely inspected.

(b) **Skylights.** Most skylights are similar in construction (Fig. 32) but differ in the means used to secure them. They are usually

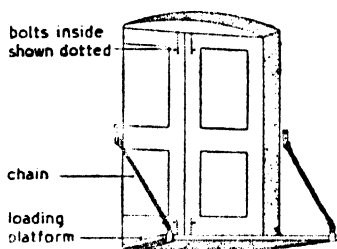


Fig. 31. Sketch showing construction of typical warehouse loophole.

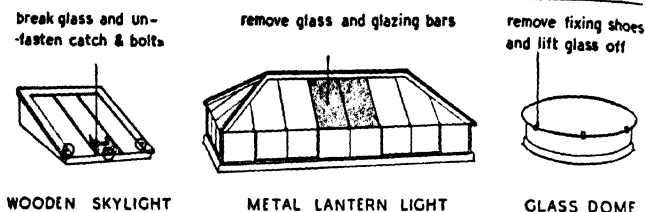


Fig. 32. Sketches showing methods of effecting an entrance through a skylight.

hinged at the higher end (Fig. 32, *left*) but may occasionally be made to slide. There are three principal methods of fastening which are :—

- (i) a simple catch ;
- (ii) a quadrant-operated device ;
- (iii) a gear-operated device.

If it is not possible to lift up the light or lever it up with the blade of an axe to part the catch, then it will be necessary to break a pane of glass to reach the fastening (Fig. 32, *left*). It should be possible in the case of a simple catch, and very probably in the case of a quadrant (Fig. 33, *left*), to release the light without further

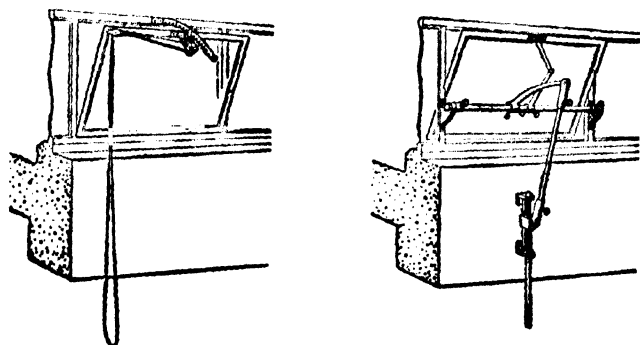


Fig. 33. Sketches showing two typical forms of skylight fastening. Left : quadrant-operated-type. Right : gear-operated-type.

damage. If not, the light should be opened sufficiently by means of the mechanism, which can then be reached by the hand, to enable the blade of an axe to be used to strike off the quadrant, thus allowing the light to be lifted right back to give a clear opening.

In the case of gear operation (Fig. 33, *right*) it may be possible, depending on the construction of the gearing, to free the moving part by undoing a nut with a spanner or by turning the operating rod by a Stillson wrench or by footprints. If not, it will be necessary to prise away the fastening on the light.

It may sometimes be found possible to free the glass by breaking away the putty on the glazing bar and lifting out the pane without breaking it. Some types of skylight, although of wooden con-

struction, have metal glazing bars, surmounted by either a lead or a zinc capping, which are often secured by small nuts and bolts; if these are removed the glass can be taken out without difficulty (Figs. 32, *centre*, and 42). Alternatively, it may be found possible with certain types of skylight to strike off the hinges and lift up the light from the hinged end, thus straining and possibly freeing the catch.

If it is impossible to free the catch and lift the light, then it will be necessary to make an opening of sufficient size to get through. As the glazing bars are sometimes only about 1 ft. apart it may be necessary to remove two panes of glass together with one glazing bar, which can be tapped up from the under side once the glass is removed. Steel-framed skylights, however, may have openings from 1 ft. 9 ins. to 2 ft. wide and are protected by a heavier type of glass, such as $\frac{1}{4}$ -in. rolled and wired, and therefore need only have one section removed for access.

When the skylight has been opened, it will often be advisable to lash it back with a line to an adjacent chimney stack, etc., or wedge it to prevent it closing again. It should never be forgotten, however, that skylights are usually situated in the highest part of a building and when opened or broken will vent the fire considerably.

8. AUTHORISED ENTRY INTO SPECIAL PREMISES

(a) *Authorised Forcible Entry.* Many commercial buildings used for storage have special fittings incorporated to facilitate authorised forcible entry. Such places are certain bonded warehouses, furriers, jewellers' shops, banks, celluloid stores, explosive stores, cold stores, etc. The doors are frequently fitted with hinges or with hasps and staples (Fig. 34), and the bolts securing them have large

strike off heads of mild steel bolts

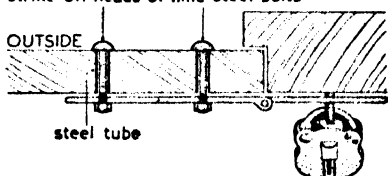
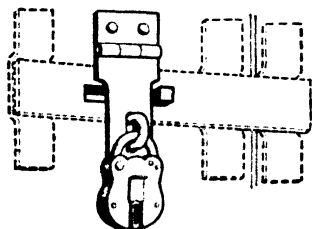
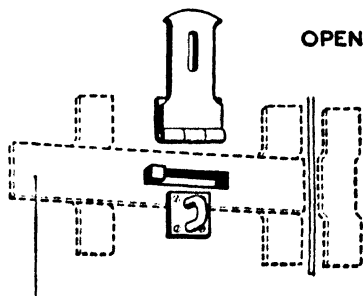


Fig. 34. Sketch showing method of providing authorised forcible entry consisting of hasp and staple secured by bolts the heads of which can be struck off.

SHUT



OPEN



bolt behind door shown dotted

Fig. 35. Sketch showing another method of providing for authorised forcible entry—the Liverpool salvage bolt. Left: bolt secured. Right: padlock struck off and bolt withdrawn.

heads which can be struck off. Once the heads have been struck off, the hinge or staple can be pulled clear, or, if it is on the far side of the door, the bolts can be pushed through the door to free it. In the latest arrangement of this type, the bolts are enclosed in mild steel tubes where they pass through the door, so that they will not bend when the head is struck off and thus jam when pushed through.

Another type is the Liverpool salvage bolt illustrated in Fig. 35. In this case the padlock is struck off and the hasp raised, whereupon the bolt, which is fitted to the far side of the door, can

be slid back without causing further damage.

Occasionally a basement is found equipped with a fireman's entrance (Fig. 36). This generally consists of a shaft fitted with a cat ladder, which leads from outside the building into the basement. The top of the shaft is generally covered by a trapdoor, often resembling a pavement light, which can be released from outside by breaking a panel of glass (coloured to distinguish it) and operating the catch below. The bottom of the shaft terminates in a lobby having double swing doors. These serve to exclude smoke and heat from the shaft and, irrespective of conditions in the basement, the fireman can get down to the level of the basement floor without punishment from smoke or heat.

In some parts of the country commercial premises may be found fitted with a

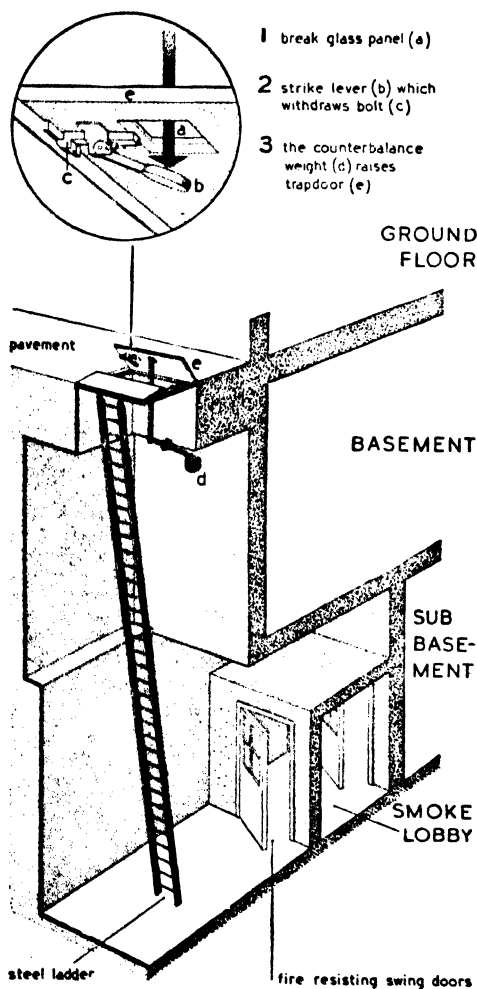


Fig. 36. Sketch showing a fireman's entrance to a sub-basement. Inset: method of releasing catch after breaking the coloured glass panel.

cast-iron bulge on the door which can be broken by a blow with a large axe, thus enabling a hand to be inserted to release the key or other door fastening.

(b) **Keys.** Sets of keys for certain premises may, in some localities, be lodged with the Police or occasionally with the Fire Service, although when this is done the Fire Service naturally will not undertake to use them in all cases if it is necessary to enter the premises. When keys are held by the Police, previous discussions will, of course, have been held as to which premises on a station's ground can be entered by this means and as to the best and most rapid means of obtaining the keys in an emergency. The quickest method will usually be for the mobilising control to notify the Police at the time of the call and for the Police to meet the Fire Service at the premises with the keys. It should be made clear to the Police and the public that if there is likely to be any delay in entering, the Fire Service will force an entry rather than await the arrival of keys.

CUTTING AWAY

I. WOODWORK

It is, from time to time, essential to cut away woodwork such as flooring, skirtings, roofing members and partitions. The most useful tools for such work are a 4-lb. hammer, a cold chisel with a 2-in. blade, a pad or keyhole saw, a floor saw, a screwdriver, a small crowbar, and two or three wooden wedges 2 ins. to 3 ins. long, the thickest part being about 1 in. For this work the saw is the best implement, provided that conditions allow its use. It is quicker and neater than an axe, and timber cut away can often be replaced with very little damage. A floor or cockerel saw is the best type, since it enables a cut to be started on a flat surface. If a floor saw is not available, it is necessary to break one floorboard so that a panel saw can be used on the remainder. One method of breaking this board is to drive the wedge end of a crowbar down into it close to the joist and across the grain, in a way similar to that suggested in Chapter 38 for making holes in floorboards to release water.

Alternatively, it may be possible to punch the heads of the nails holding the end of a floorboard to the joist down through the board, so releasing it. The end is then prised up and the board levered out of position, thus allowing access to the other boards, which are prised up in turn.

When cutting boarding the cut should always be made as close as possible to the edge of the joist. If, then, the cut has been started with a saw the board can be replaced in position on a fillet nailed to the joist (see Fig. 37), and no new timber will be necessary. When making a cut in flooring it should not be overlooked that there may be gas or water pipes or electric cables in the space below the floorboards (Plate 28 facing p. 140). If, therefore, the saw seems to be striking metal, the operator should stop and investigate. Having removed the first board, it is always wise to feel below the boards it is proposed to cut next, to verify that the space below is clear. When one or two boards have been cut it may be quicker to strip up the remainder to clear the necessary space, since a crow-

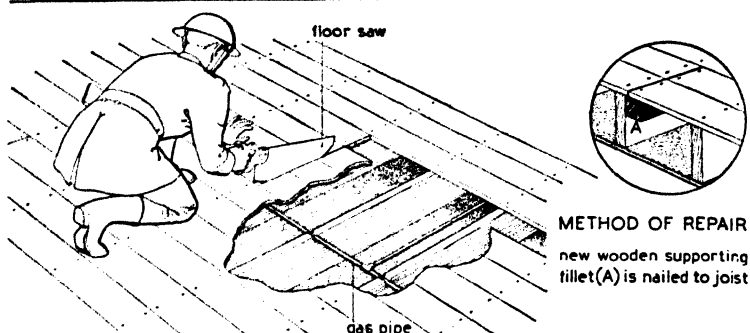


Fig. 37. Sketch showing correct method of cutting a floor board with a floor saw. Note danger of cutting concealed gas pipe. Inset: method of repair which can be used if cutting away has been carefully carried out.

bar can readily be inserted between the floorboard and the joist, and the former prised up without damaging the boards.

Where the use of a saw is impossible the large axe is the alternative generally employed. The axe should be held (for a right-handed man) as shown in Fig. 38. It is, of course, obvious that the grip

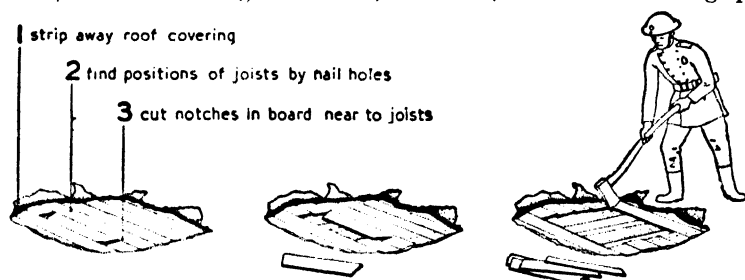


Fig. 38. Sketches showing method of using an axe to cut boarding on a flat roof.

will have to be altered if working in a confined space, since it may often be necessary to cut left-handed. More control on the axe, and consequently more accurate cutting, will be possible if the swing is relatively short.

Timber, irrespective of its size, should preferably be cut across the grain, the blade of the axe striking the surface of the wood at an angle so as to make a wedge-shaped cut which is progressively enlarged as the wood is cut into. To cut flooring, a point should be selected as near as possible to a joist (as indicated by the line of nails) and a vee-shaped cut made across the line of the planks. The support below will reduce the spring in the wood and give a cleaner cut. It is preferable for two men to operate together when cutting flooring, each starting at opposite corners of the part to be cut and working in opposite directions.

When it is necessary to remove skirtings to look for the spread of fire, it is usually much less damaging to clear the whole length of the piece of timber than to cut it at any mid-point. This indeed

applies in the case of almost all woodwork, since the piece can then be replaced as a whole. Skirtings can often be sprung away from the wall near the centre of the run, using the blade of a large axe.

Panelling is usually thin and will indicate to the touch whether there is fire behind. Where possible, the panels should be removed intact by prising off the beading. This applies particularly in the case of old panelling, which may be extremely valuable; in such cases it may even be advisable to remove a whole section of the panelling intact rather than attempt to cut out an affected panel. The method to be adopted will, however, depend to a considerable extent on the nature of the panelling. In all cases where the panels themselves are of particular value because of paintings or carvings upon them, it is obvious that the woodwork should be removed in the way that will cause least damage to the most valuable part, but in other cases, as with the modern type of thin matchboarding, it may be better to cut out a section with a floor saw.

Timber work in special risks such as flour mills, etc., requires special attention, for dust extractors, grain conveyors and chutes, which are often encased in timber, are a frequent cause of fire spread. Sections of these conveyors and chutes should be opened at regular intervals, but it is wise in such circumstances to obtain the assistance of the engineer in charge, who will be able to point out the whereabouts of inspection covers, etc., and suggest methods of opening up which will cause a minimum of damage.

2. PLASTER

It is frequently necessary to pierce or pull down a ceiling, or to cut through a lath and plaster wall.

(a) *Ceilings.* Without question, the most used tool for piercing ceilings is the ceiling hook. Ceilings may have to be holed to get at fire which is travelling in the laths or woodwork or to release water from above, the signs of which are sagging due to the weight of water and the presence of beads of moisture. Portions may also have to be removed because they are dangerous and liable to fall. When pricking a ceiling, the operator, having chosen the position of the opening to be made, should stand well away from beneath it (Fig. 39) and with the point of the ceiling hook, the bill held downwards, remove some of the plaster. This will expose the laths and the direction in which they run can then be ascertained. If it is desired to pull down lathing to make a hole for entry or to remove burning material, the hook should be pushed up between the

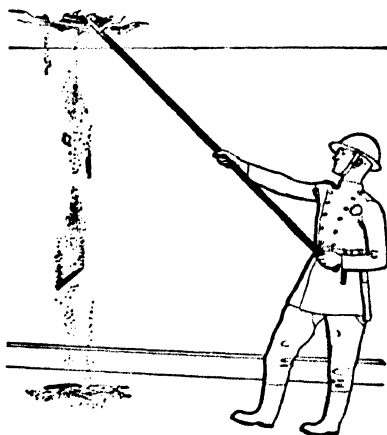


Fig. 39. Sketch showing correct method of standing when pricking a ceiling.

laths and rotated through a right angle so that the bill lies above the laths. A sharp pull will then remove the laths and the operation can be repeated until a hole of sufficient size is made.

Where the ceiling hook is fitted with a cutting edge on the upper surface of the bill, after the position of the joists has been found, the laths can be cut or broken by forcing them with short, sharp jabs against the joists (Fig. 40). This will often result in a neater hole, since it will not pull down long runs of laths, as may occur if the former method is employed. It might be well to remember that heavily papered ceilings often bulge and give a false impression of impending collapse. In such cases a small prick through the ceiling will often allow the water to run away; the ceiling hook should, therefore, always be used lightly in the first instance. If the ceiling is still safe and it is necessary only to release water, then several small holes should be made in the plaster only.

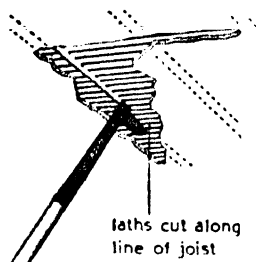


Fig. 40. Sketch showing method of cutting laths with the bill of a ceiling hook.

This can conveniently be done by using the point of the ceiling hook corkscrew fashion. There is then less danger of disturbing the lathing and of bringing down the ceiling.

A ceiling should only be pricked after such arrangements as are possible in the circumstances have been made to catch, either by buckets, tubs, salvage sheets, etc., the water which will be released. Where equal effect can be obtained, the prick should be made near a window, so that water can be diverted out by means of a chute (see p. 212, Fig. 20).

Certain types of ceiling may be found plastered on metal lathing or expanded metal work which is suspended at intervals from the joisting above. Where this is believed to be the case, the operator should stand in a doorway or at a point from which easy escape is possible if, as may be the case, the whole ceiling begins to come down. If the plaster of a ceiling shows signs of falling and the operator cannot retreat to safety he should get in a doorway or under a beam or, if this is impossible, he should stand upright, so that the ceiling breaks about his helmet. If he crouches it will fall on his back and may knock him flat on his face.

(b) Lath and Plaster Walls. It is often possible to detect lath and plaster walls by gently tapping them and listening for the alternate hollow and solid sound produced by the presence of the spaces between the studding.

The best place for opening up is between the uprights, the location of which may be ascertained by tapping on the wall with the shaft of the axe: where the wall sounds solid there will usually be found a stud. The outer edge of the portion to be cut away should be outlined by carefully chipping through the plaster with the blade of the axe. The plaster may then be chipped or levered away from the lath with the point of the axe, and the laths gently hacked or sawn away without damage to surrounding portions of the wall.

3. BRICKWORK, ETC.

It may be necessary to cut through brickwork as a last resort to obtain an entry, but it is more generally necessary for such purposes as removing part of a flue or a shaft for inspection, or to reach a fire. If it is necessary to cut through a wall to enter a building, the type of construction should be carefully examined and both the wall and the part of the building which will give least trouble should be chosen. An architect or surveyor should, if possible, be consulted before the work is undertaken, for it is possible by selecting the wrong place for operations to cause the collapse of an old building. Brickwork increases in thickness the nearer the foundations, so that the highest practicable level in the building at which to cut a way through should be chosen.

To open up a brick wall it is necessary first to prise out a brick with a hammer and cold chisel, and then to open out the cavity so formed by removing further bricks with a crowbar, working round the circumference of the hole. This method will allow the bricks to come out more easily, will minimise damage to the rest of the wall and will facilitate repair. Rubble walls, such as those built of flint or random blocks of stone, should be dealt with in much the same manner as a brick wall. If working in a room it is desirable to have receptacles such as buckets, etc., in which to place the debris for ease of removal and to minimise damage to the room.

4. REMOVING ROOF COVERINGS

It is not infrequently necessary to remove roof coverings, either to reach a fire in the roof or roof void or to ventilate the building, and just occasionally to obtain entry to the premises. Each type of roof presents a separate problem and the means of access through roofs may therefore be classified under the various types.

(a) *Pitched Roofs.* The general construction of these roofs has already been dealt with in the Chapter on "Building Construction." It is always essential to start operations at the highest part of the desired opening and work downwards.

(i) *Tiled Roofs.* Tiles are usually laid in position (without nailing) on battens, which in the better type of construction are nailed on to close boarding. At the highest point of the opening which it is proposed to make, the first

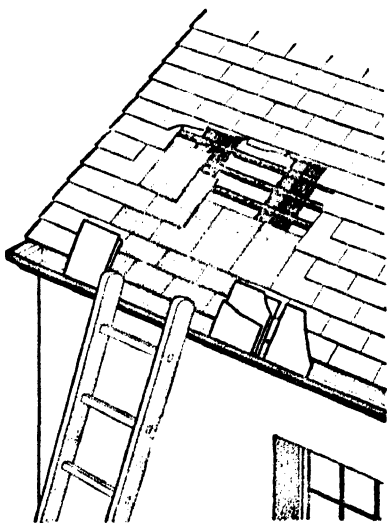


Fig. 41. Sketch showing method of removing roof tiles.

tile should be lifted with the axe and then slid out. Further tiles can then easily be removed until a sufficient area has been cleared. As the slates or tiles are removed they should be stacked neatly, clear of operations, if the construction of the roof permits. It is often possible to rest them against the guttering (Fig. 41). Alternatively, the slates or tiles may sometimes be piled on the chimney stack, where they will be out of the way.

If the roof is close boarded it will be necessary to cut a hole of sufficient size with a saw. The position of the rafters (showing where the boards should be cut) will be obvious from the lines of nail heads. If the tiles rest on battens only, then the number of battens to give the required size hole will have to be cut or chopped away. If the hole is being made to obtain access to the roof space, the aim should be to make a hole some 2 or 3 ft. square and about 3 to 4 ft. from the base of the roof, but without cutting the rafters. Unnecessary cutting away of woodwork may seriously weaken or even collapse the roof. Once the hole is made the fireman can lower himself through the gap between adjacent rafters (which are at least 14 ins. apart) into the roof space. When doing so, however, he should make sure that his feet are on the joists and do not go through the plaster of the ceiling, which is usually exposed (see p. 57, Fig. 24).

(ii) *Slated Roofs.* Slated roofs are constructed and can be opened up in much the same way as tiled roofs by working from the highest point, but the slates are nailed in position on to the battens. It will usually be necessary to break the first few slates until the heads of the securing nails are exposed, when it will be possible to prise up the slates with relatively little damage.

(iii) *Corrugated Iron or Asbestos Roofs.* Corrugated iron sheets should be lifted off whole, it being usually possible to knock off the heads of the bolts securing the sheets with a large axe. If any difficulty is experienced the sheeting can usually be driven in

around the bolt holes by means of the pick end of the fireman's axe or a crowbar and the remainder of the sheet lifted off. If time permits, asbestos sheets can be treated like corrugated iron roofs. The asbestos is, however, usually brittle and tends to crack and fly.

(iv) *Glazed Roofs.* Many factories and the top floors of warehouses, office buildings, etc., are fitted with north light glazing (the so-called saw-tooth roof construction). The sheets of glass are often merely laid on steel glazing bars and then flashed with lead. If the lead is lifted with a penknife, axe,

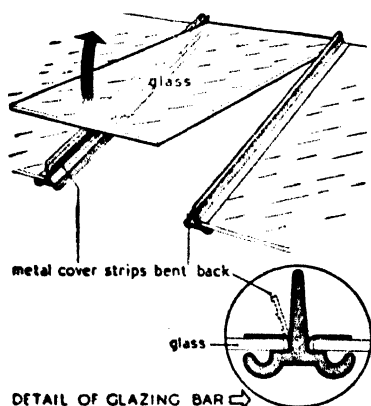


Fig. 42. Sketch showing method of removing panes in a glazed roof.

etc., the glass can be removed whole and without damage (Fig. 42). If it cannot be freed in this way it should be broken away to give the necessary size of entrance. Wired glass will often come out as a single sheet in the same way.

(b) *Flat Roofs.* Such roofs are usually covered with cement, asphalt, lead, copper or zinc and may vary greatly in construction. Those in modern buildings are often of hollow tile or concrete below the covering and cannot be opened up.

Both lead, copper and zinc are normally laid on close boarding, so that after the metal has been removed the boarding must be cut through. If lead, copper or zinc cannot be removed in sheets they can be cut by using the blade of a large axe as a chisel (Fig. 43) and drawing it along the line of the proposed cut while it is struck a succession of light but frequent blows with a hammer or the back of another axe.

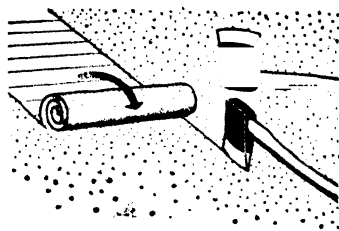


Fig. 43. Diagram showing one method of cutting roof material.

(i) *Lead Roofs.* The lead should be lifted at the gutter and rolled back as a sheet, cutting away as necessary the lead dots fastening it to the adjoining sheets.

(ii) *Copper and Zinc Roofs.* Copper and zinc coverings can usually best be removed by lifting the securing nails at the lapped joints, where the sheets are usually arranged over wooden battens to provide the necessary fall to allow the water to run off.

(c) *General Precautions.* When opening up a roof, suitable ladders should be handy for use in reaching the inside of the building. If fire is suspected, or known to be present, caution should be used, as there may be a sudden updraught of hot air through the hole which has been made, and the increase in ventilation may cause a rapid spread of the fire. The men making the cut should, if possible, stand to windward, so that the rising smoke and fumes will be carried away from them.

5. WORKING ON ROOFS

Men should never be allowed to work on a pitched roof unless every precaution has been taken for their safety. If it is necessary to work on a sloping roof a hook ladder or short extension ladder should be used to give a foothold. If a ladder is not available and it is necessary, in an emergency, to work on such a roof, a line made fast round a chimney stack (Fig. 44) may give a secure hold. Except for flat roofs which have been specially designed for adequate loads, too much weight should not be placed on a roof at one time, and only the minimum number of men necessary for the work in hand should be allowed on the roof. It is always advisable for men working on roofs to have a long line with them, and they should always be in pairs.

In the case of a roof through which a party wall projects the ladder should be pitched as close as possible to the wall, for the roof

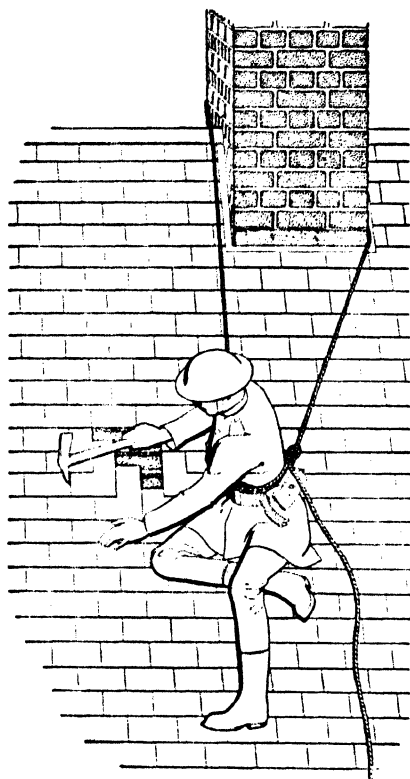


Fig. 44. Sketch showing correct position for working on a pitched roof, and method of securing oneself with a line.

is usually stronger close to a party wall and the wall may be used as a handhold to climb to the ridge. It is advisable to size up such handholds before any weight is put on them, for the mortar is often old and in poor condition and the brickwork is liable to come away if any sudden strain is put upon it.

The strongest portions of a roof are the ridges or valleys, but it should be remembered that if there is a fire in the roof void the highest part will be the hottest and will also have been most weakened.

The ascent to the ridge of a roof should be made, if possible, in a direct line with a chimney stack or any object lower down the roof which, if the fireman slipped, would prevent him falling off.

When walking on slates or tiles the foot should be placed on two slates at once, as in this position the supporting strength is greatest.

When working on a roof the fireman should always hold his axe in his hand with its point downwards, so that if he starts to slip the point can be driven through the roof to provide a grip. The time taken to withdraw an axe from its pouch may make all the difference between safety and falling off the roof.

To work on the sloping portion of a roof, one leg should be doubled under the knee of the other, so that as much as possible of the body is in contact with the roof (Fig. 44). To ascend a sloping roof without a ladder or other similar hold, it will usually be found best to work up backwards in this position until the ridge is reached. With a correct seat on a roof it should be almost impossible for a man to slip, provided that the roof is of normal pitch and that it is not icy. If the fireman feels himself slipping and has not his axe, he should roll on to his face and press the palms of the hands on to the slates or tiles. When working for any length of time on a roof with a precarious foothold, it will help if a few slates or tiles are removed to expose the battens, which will give a good grip.

Roofs formed from cement asbestos sheeting, both plain and

corrugated, are particularly dangerous, and the open roof surface should never be trusted to bear any weight. If walking on such a roof is unavoidable in an emergency, the bolt heads protruding through the roof will indicate the position of the purlins supporting it, and hence the strongest part. Skylights may frequently be blackened over either with paint or smoke, and many accidents have occurred through firemen mistaking the glass for solid material such as slate, particularly in the dark. Corrugated iron also may frequently be rusty and give way; and in winter, snow may mask dangerous conditions. Care should be exercised in standing on a close-boarded bitumen covered roof if it is suspected that there is fire or any considerable amount of heat below. Such roofs tend to collapse very suddenly, without warning. When standing on a flat roof which may have been weakened by fire, it is advisable to keep near the edge. A ladder laid down flat to form a duckboard will also help to distribute the load. Use should never be made of guttering, and men should avoid walking or relying on projecting coping stones, which may be cracked or weak.

The presence of a catwalk often indicates that the main part of the roof is not capable of bearing a man's weight. This applies in particular in the case of catwalks in the roof voids of cinemas, theatres and other buildings with large false ceilings, which may be of very light construction. When working aloft, slates or tiles should not be dislodged and windows on upper floors should not be broken without warning those below. Slates may fly for considerable distances owing to their thin, flat shape, and the edge can cause fatal injury. If, because of the noise of the fire, those below cannot hear a call, a few small stones or bits of slate or tile can be dropped as a preliminary warning that other and larger pieces may shortly be falling.

6. DANGERS ON ENTRY

When entering a building, many possible pitfalls may be encountered and, moreover, there may be dangers outside the premises which will have to be guarded against before entry is obtained. The yards of industrial premises often present innumerable pitfalls to strangers, and care should be taken when negotiating such places in darkness. Open stokeholds, external cooling vats or pits and similar dangers are likely to be encountered.

When pitching a ladder to the front of certain buildings fitted with luminous discharge tube lighting, the "fireman's switch" (see the Chapter on "Electricity and the Fire Service") should first be operated. A point to be remembered is that if men have entered a building from a ladder, they will be relying on it to make their way out again. A ladder, therefore, should never be removed except with the express permission of the officer in charge, otherwise men inside may be trapped.

Even apparently normal means of entry such as doors and windows may sometimes conceal unsuspected dangers. Doors occasionally open on to a lift shaft and not infrequently direct on to stairs, particularly doors leading to basements, and the incautious who open such a door and step straight in run a serious risk of a

fall to the bottom. Similarly, it is essential when entering a window from a ladder to step in carefully and not to jump in; the window may open on to a staircase or well, or the floor may have collapsed. An overhead trapdoor should be opened in such a way that any hot embers which may be released do not fall down the sleeve of the fire tunic and cause unpleasant burns.

If it is suspected that there is an explosive mixture present in the building and a sparkproof electric handlamp is not available, the lamp should be switched on before the building is entered and switched off only after the building has been left so that any sparking at the switch may not cause an explosion.

(a) *Doors.* The possible dangers which may be encountered when using external doors have already been mentioned. Danger may also be experienced from internal doors. When opening up an internal door behind which fire may be encountered, the possibility of backdraught or an explosion due to the accumulation of dangerous gases awaiting the admission of air should not be overlooked. Warning of the presence of such gases is sometimes given by the nature of the smoke in the compartment, if this can be seen through a window. Thick billowy clouds of yellow smoke are usually an indication of dangerous conditions. The most obvious and best warning of danger is, however, the presence of heat. When opening

a door behind which fire is suspected, the handle should be touched carefully. If the handle is hot, the corner of the tunic may be used to grasp it. The metal shank connecting the two door knobs is a good conductor of heat, and some idea of the temperature on the other side may be gained from this. It should first be tested with the back of the hand for temperature, in case it may have been electrified by a fallen cable, to avoid the man gripping the handle and being unable to let go. Where it is suspected that the room which is to be entered is already on fire, the door should not be opened except for rescue purposes without a branch being available for the immediate application of water to the fire. Blister-

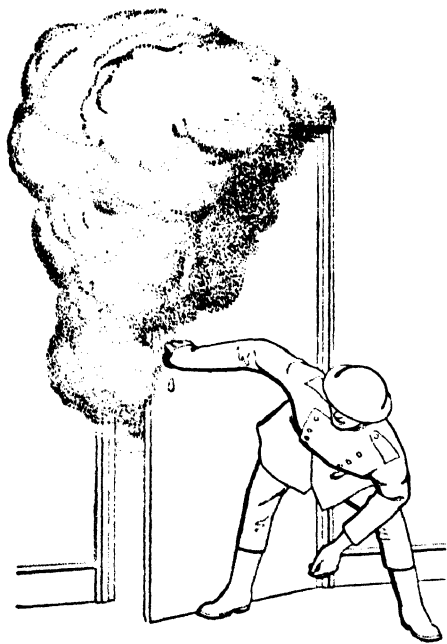


Fig. 45. Sketch showing correct method of opening a door behind which fire is suspected.

ing of the paintwork also will form a reliable guide to the heat within, as will also the crackling sound of burning woodwork. If the door swings towards the operator the foot should be placed against the bottom and one hand on the door, as shown in Fig. 45, and the handle turned gently. There may be a considerable pressure in the room due to the expansion of the heated gases which would otherwise force the door out of the grasp. It is desirable for the fireman to crouch in such a way that any heated gases or flames which are released pass over the head.

Finally, the fireman should beware of mistaking an external door for an internal door when opening up. Certain types, such as loop-holes, may lead into space.

(b) *Stairs.* Stairs present an obvious source of danger when a building is entered and should always be treated with caution until their condition is known. Certain types of stairs in particular, such as those of stone which are not enclosed and which are supported at one side only, may be very dangerous and may collapse if, after having been heated, they are cooled by water from a jet (Plate 25, facing p. 140). It is not necessary for the flames to reach them for this to happen.

Stone stairs which are supported at both sides and enclosed in a tower staircase are usually very safe, and fires can often be fought from them when other parts of the building are untenable. Wooden stairs, on the other hand, will seldom collapse without warning but may become so weakened by charring (Plate 26, facing p. 140) that portions of them will give way beneath the weight of a man ascending them. When ascending or descending stairs, therefore, the fireman should always keep close to the wall, since the treads will usually bear weight at this point even though their centres may be weakened. If there is any doubt as to their strength only one man should be allowed on each flight at a time. In the case of

spiral stairs, keeping to one side will also ensure the use of the part of the stairs with the widest tread. Care should be exercised in using the balustrade when ascending or descending stairs, since it may have been weakened by charring and collapse if any weight is applied to it. Cast-iron balustrades may be sufficiently heated to burn the hand if touched and may be weakened or give way altogether if any strain is put upon them.

If a staircase has been seriously damaged by fire, scaling or other

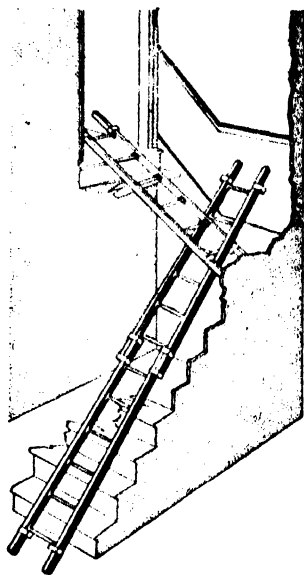


Fig. 46. Sketch showing one method of replacing a damaged staircase by means of scaling ladders.

ladders should be used to improvise a stairway. One way of doing this is shown in Fig. 46.

(c) **Floors.** If a building has been seriously affected by fire, floors, particularly those above the fire, may have been weakened sufficiently to become dangerous. Heat which is sufficient to burn through a floor will probably be apparent before entry is effected, but, nevertheless, every care should be taken to keep close to the walls in case the structure has been seriously weakened by fire. Floors above a fire tend to be weakest in the centre and above windows (due to the concentration of the escaping heat at the outlet). The most usual method of detecting weakening is to inspect for the depth of charring and see whether or not the floor is level. A floor which is "live" (*i.e.*, movement is felt when men walk upon it) should always be suspected.

A floor with a certain amount of water on it is usually safe, because it indicates that there are no holes, and, if there is fire

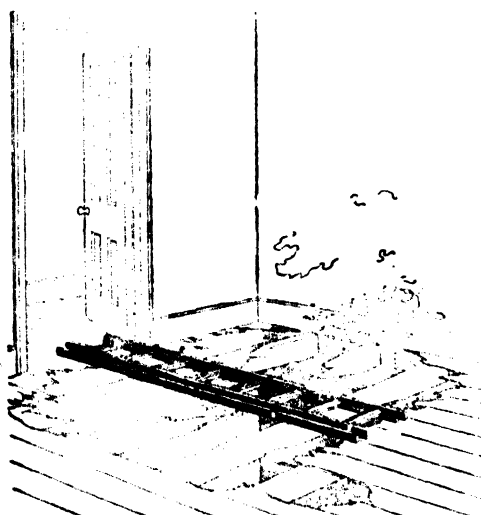


Fig. 47. Sketch showing one method of bridging a damaged floor.

below, that the heat is probably not sufficiently intense to have weakened it below its safe load-bearing capacity. On the other hand, the presence of any considerable depth of water may mean that a floor is excessively loaded and any additional weight might cause it to collapse. If conditions permit, it is desirable to go to the floor below and look at the underside of where it is proposed to work, to see if there are signs of fire, the extent of the charring, the size of the joists, whether joists and columns are

in place, and to look for any points of movement in the structure. A floor which has been seriously damaged can be bridged by the use of a ladder (Fig. 47).

In some older buildings, stone floors (see Plate 27, facing p. 140) may be encountered, and these are a positive danger when subjected to heat. Care should be taken not to apply a jet in order to cool a stone floor to walk upon, as this usually causes cracks to appear. Stone and concrete which is not reinforced are brittle when subjected to heat, and collapse easily.

It is frequently found that in old property which has been converted into a small workshop, the floors are unduly loaded with



Plate 25. An excellent example of the effect of heat on stone steps supported at one end only. Additional cracks can be seen on the right-hand side.

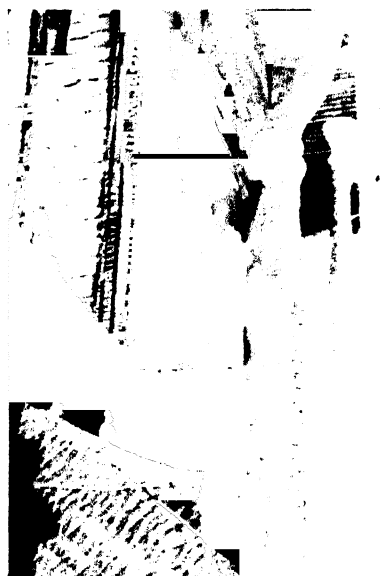


Plate 26. Effect of a severe fire on a wooden staircase. Note that much of the woodwork is still in position, even though considerably weakened. Compare this photograph with Plate 25 which shows the effect of heat on a stone

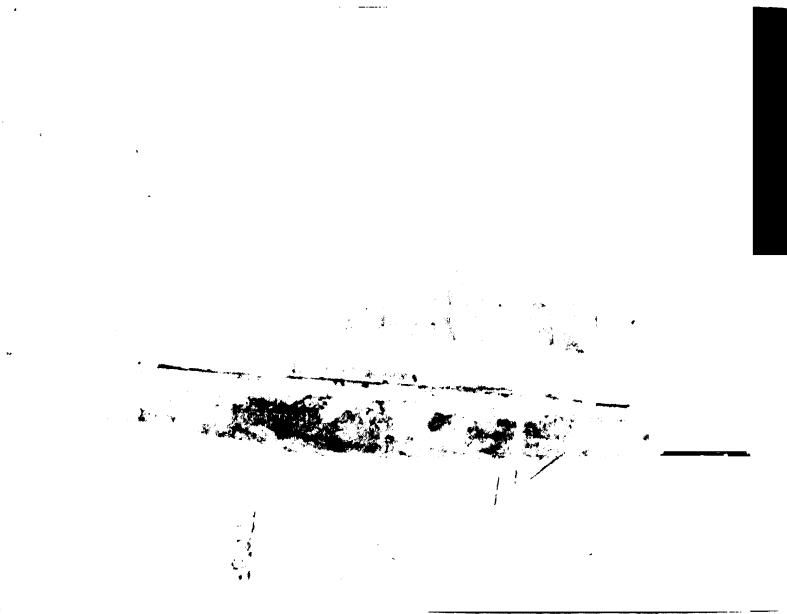


Plate 27. Photograph showing an unusual type of construction sometimes encountered in old premises. The floor, composed of slate slabs, part of which can be seen on the left, is supported on cast-iron joists. Part of the slate has collapsed, revealing woodwork on the floor above. At the bottom of the photograph can be seen a further cast-iron joist with the slate slabs still in position, spanning between it and the one in the foreground. This construction would, of course, be very dangerous to men working on the floor above a fire, since the slate would fail without warning.

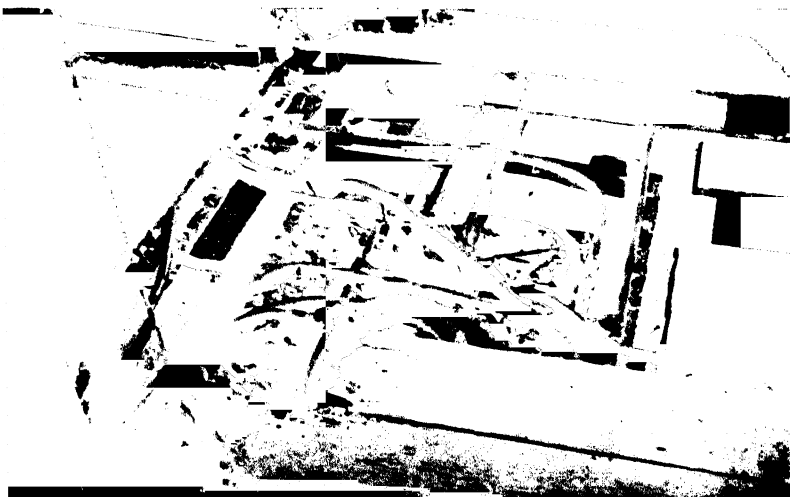


Plate 28. This photograph, taken at a small fire in very old property, clearly shows the danger of sawing through floorboards without making preliminary investigations to see whether piping, wiring, etc., runs below.



Plate 29. Interior of a lift motor house. Note the winding handle in position on the end of the motor shaft whilst a second man releases the magnetic brake. The traction sheave can be clearly seen immediately to the left of the control panel.



Plate 30. Photograph showing a dust chute, down which a small boy fell from the top and was trapped. The chute is 9 ins. square and it was necessary for the Fire Service to cut away the brickwork to free him. Note how by breaking out bricks initially it has been possible to remove a number of them almost whole.



Plate 31. Photograph showing the use of the horse sling to extricate a horse trapped in a manhole. Note the use of tackle to obtain a vertical pull in an awkward situation.



Plate 32. Use of horse sling to raise a horse which had fallen down an excavation.

NOTE.—Impossible as it may appear, the animals shown in both the above photographs were rescued uninjured.

machinery and, if time and conditions permit, it is therefore wise to have a quick glance at the floor above that on which men are at work, to verify conditions. Consideration should be given to whether or not there has been any fire underneath the room being entered, as certain types of floor can be weakened quickly by fire underneath. The torch should be flashed round first to ascertain what type of machinery or goods are stored on the floor, in order to assess their weight and to see whether or not the ceiling has been struttred as an indication of unusual loading. In all cases, personnel should keep as near the walls as possible, especially in rooms such as the spinning rooms of cotton mills, where the centre of the floor carries a very considerable weight of machinery. Finally, it should not be overlooked that the floors in certain buildings such as garages, woollen mills, etc., may be very slippery.

(d) *Special Hazards.* There are many features which present a hazard in differing types of building. It is impossible to catalogue all these for they vary so widely. Those of major importance, however, are discussed below.

(i) *Electrical.* As a room is entered, the fireman should consider whether, if the current has been left on, the conditions are such that the electric lighting fittings are likely to cause a hazard (see discussion in Chapter 32). The chief risks lie in hanging wiring which has come away from its supports, but all electric fittings should be treated with caution. Switches should be operated with the handle of an axe and not with the bare hand. For further details of electrical hazards see the Chapter on "Electricity and the Fire Service."

If the current has been left on, the question of the fireman using a lift may arise. Unless the seat of the fire has already been found and it is known to be a minor one, it will be dangerous to use a lift. Cases have occurred where persons using the lift in a building on fire have been taken up to the floor affected through a fault in the lift mechanism caused by the fire. There is also the danger that the electric current may fail, and the lift stop and trap the occupants between two floors. The best rule is, therefore, when in doubt never use the lift. On the other hand, at a minor fire the use of a lift may save considerable time (*e.g.*, in bringing up equipment) and the possibility should, therefore, not be overlooked.

(ii) *Constructional.* The importance of a sound knowledge of building construction has been emphasised in the Chapter on "Building Construction." Some of the more obvious dangers resulting from particular types of construction are mentioned below, but it will be apparent that this list is by no means exhaustive, and the fireman should always be on his guard against possible dangers resulting from the use of new or unusual materials in the construction of a building. Lightweight steel trussed roofs with exposed steelwork may fail rapidly under the influence of fire, and unprotected cast-iron columns present a serious danger if subjected to great heat and then suddenly cooled, since they may collapse with very little warning, bringing down the joists and possibly the building with them.

Certain of the modern roofing materials present serious danger to firemen. Asbestos cement sheeting may break up into fragments with almost explosive force, whilst molten bitumen may fall and cause serious burns. When working in the vicinity of a flat roof there is always a possibility of falling molten lead or glass. Fragments of broken glass always present a danger, and large pieces of stonework may frequently spall off under the influence of heat and flame.

If the fireman must remain for any length of time in one place inside a building seriously affected by fire, he should stand under a weight-carrying beam or girder.

(iii) *Industrial.* Particular caution should be exercised when entering industrial premises, since there may be many hazards associated with the processes carried on, such as plating baths, tanning pits, large vats, oil quenching baths, open light shafts, etc. Both private and public garages frequently possess one or more inspection pits, which in many cases are not kept safely covered, whilst large hoists may often be found in public garages. In some types of warehouse in Liverpool, for instance, there may be found square trapdoor openings used for trimming stock, many of which are spring-loaded in order to keep them in position when not in use. The trapdoor gives the appearance of being a solid portion of the floor, but if its securing bolts are not properly fastened it would give way with serious results when trodden on.

It would be impracticable to set out all the dangers likely to be encountered in industrial premises, but a study of the chapter on "Special and Unusal Risks" will give a guide to the types of risk to be expected in connection with particular industries. New processes are, however, always being developed, and the fireman should always be on the alert when entering or working in industrial buildings.

It is the practice of some firms to indicate by notices posted in appropriate places the presence of particular hazards such as salt or oil quenching baths, the presence of ammonia, etc. Common sense combined with wide experience and local knowledge will best serve to guard the fireman against misadventure in a building on fire.

METHODS OF RESCUE

THE rescue of persons trapped by fire or smoke has always been a primary function of the Fire Service. Often this work is made doubly difficult by the unreasoning fear which fire and smoke induce in those people who are, or who believe themselves to be, cut off from safety. With people in this plight there is a strong tendency to throw themselves down from a window or a roof into the street, notwithstanding that they are in no immediate danger and that help is close at hand and can be seen coming to them. On arrival, therefore, at a fire where persons are observed to be crying out for help, the fireman should call to them, reassuring them and telling them in firm loud tones not to jump.

Due to fear and excitement, persons will often forget alternative ways of escape which, in calmer moments, they would have remembered. They will even forget to shut the door of the room in which they have taken refuge, so allowing the entry of smoke. Loss of presence of mind may make the persons trapped overlook the fact that their room has a balcony or perhaps a broad window-sill on which they can find temporary refuge.

I. GENERAL

Rescue work divides itself into two broad categories :—

- (a) Rescue by ordinary means.
- (b) Rescue by Fire Service equipment.

(a) Rescue by Ordinary Means. Many rescues are accomplished yearly simply by firemen reaching those who are awaiting help, reassuring and comforting them, and then perhaps leading them to safety by a way they have forgotten or through light smoke which has temporarily made them lose confidence.

On other occasions the correct procedure will be for the fireman to keep those to be rescued where they are, remaining with them so as to give them a feeling of confidence and safety, whilst the fire, which may be one or more floors away, is extinguished. As soon as stairways have become clear of smoke these persons can be led to safety. If the fire should render this procedure not possible, then the fireman can remain until rescue apparatus can be brought to bear by other firemen.

In cases of rescue by ordinary means it should be remembered that the fireman can withstand far more heat and smoke than can the average member of the public, and may be able to ascend a staircase past the floor on fire in order to reach persons trapped on the roof or on upper floors.

A good example of what can be achieved by such means was

afforded by a fire in a departmental store in a large city in the Far East in 1932, when 150 people were trapped on a high roof, which it was impossible for the Fire Service to reach with a ladder. After considerable effort an officer managed to get through the heat and smoke on the lower floors (which had rendered all stairways impassable by the public) and make his way to the roof, where he succeeded in calming the crowd sufficiently to persuade them to remain where they were. When the fire was checked they were able to escape by way of the staircases in the building itself. An unusual method of rescue was attempted at this same fire, when army aircraft flew over the building and dropped lines on the roof. They were not employed, however, because it was subsequently found possible, after the heat and smoke had cleared, to use the staircases.

(b) *Rescue by Fire Service Apparatus.* The safest method of rescue is to bring persons down an escape or down a turntable ladder. Rescue by line, though often the only method available, will always involve some risk, either because of the possible chafing of the lowering line on, say, a roof cornice, or through the rope breaking because acid has found its way to the rope since it was last tested, and so caused it to fail under the strain of lowering a body. Unless great care is taken there is also the possibility of a rope taking charge and slipping through the hands, particularly in very cold weather when fingers may be half frozen.

(c) *General.* No hard and fast rules can be laid down as regards rescue work. Every job will be found to have individual features, and experience and training will alone enable the fireman to decide as to the best method or combination of methods to be employed.

Some rescue jobs permit of not a second's delay. Here will be no time for ceremony, and persons to be rescued may have to be bundled, one after another, out of a window, down an escape from fireman to fireman if lives are not to be lost.

Useful qualities for a fireman taking part in rescue work are agility, balance, ability to preserve a sense of direction and location when working blind in a smoke-filled building, and the capacity to withstand heat and smoke punishment. Finally, common sense combined with experience at actual fires and rescue jobs will produce the higher qualities of intuition and sound judgment which will enable the firemen to appraise the situation correctly and do the right thing. Thorough training is, of course, essential, for it is this which enables a fireman to improvise and extemporise when the time comes for a rescue to be carried out which is not straightforward. The following are points to bear in mind at rescue jobs :—

(i) Where possible, an escape or ladder should be pitched to any window at which people are seen or have been seen.

(ii) It will often be found that rescues can only be performed successfully if water is immediately got to work on the fire, and the need for this should never be lost sight of by the officer arriving at a rescue job. If a pump is close on the heels of an escape, the getting of a branch to work can be left to the pump, but, if not, one member from the escape's crew should be detailed to do this.

A fire left alone may spread rapidly and reach an intensity which

may prevent rescue work being carried out, and so lives will be lost. At other times it will be necessary to protect and screen the rescuers at the head of an escape, by spray or a jet.

(iii) The building should be searched. The occasion when persons are seen calling for help will not be the time for putting on breathing apparatus, but where no one is visible and the building is smoke-logged, a job of longer duration is likely and the extra time taken to don breathing apparatus will enable the work of searching to be done more thoroughly whilst conserving the strength of the rescue party, who may have some strenuous work to do on reaching those to be rescued.

The officer in charge of a smoky rescue job should bear in mind the advisability of ordering on additional breathing apparatus, for nothing is lost if it arrives too late to be of use, whereas a building, such as a hotel, which has become smoke-logged will take a number of pairs of breathing apparatus men if every room and floor is to be searched.

(iv) Where persons are reported in a building, the Fire Service officer should always remember that they may be calling for help from a back window, and he should make a practice of seeing whether this is so. To do this, it will often be convenient to send men, carrying hook ladders, through the next-door house to where they can get a sight of the rear of the premises involved.

(v) The moment it is known or believed that there are people to be rescued from the building, an ambulance should be ordered. Persons suffering from smoke or burns need immediate medical attention and, generally, should be conveyed to hospital without any delay. It may sometimes even be desirable to arrange for a fireman to accompany them in the ambulance in order that resuscitation may be continued on the way to hospital.

(vi) As soon as branches are in position on the fire the building should be ventilated by opening all windows and doors, so facilitating the searching of the building.

(vii) Darkness tends to induce fear in many people, certainly to add to difficulties and to make things seem worse than they are. Accordingly, a building on which rescue work is being carried out should be flood-lit at the earliest possible moment.

(d) Lectures. Fire Service officers will find many opportunities for talking or lecturing on rescue work, and the following points should also be made :—

(i) Before going to bed, every room in a house should be shut, so ensuring that should a fire start in one of them it will be contained long enough to enable the occupants of the house to make their escape. Had this simple precaution been carried out in the past, many lives would have been saved.

(ii) Persons trapped by fire or smoke should make their way to a front room window, from where they can make their plight known to passers-by, who will call the Fire Service. There is the further point that the windows at the front of a house are usually much more accessible to escapes and ladders than those at the rear.

(iii) The public should be reminded that when staying in a hotel

or private house with which they are not familiar, they should before going to bed note whether there is an alternative means of escape in case the main staircase is impassable due to smoke or fire.

2. RESCUE WITHOUT THE AID OF FIRE SERVICE EQUIPMENT

As has already been said, many rescues are effected without the aid of Fire Service equipment. On arrival at a rescue job, therefore, if there is no one at the windows, it is advisable to slip the escape or ladders, but to defer pitching them until it is known where they will be of most value. Appliances pulling up at a rescue job should always be kept clear of the building, so that escapes or turntable ladders can be got to work, if necessary, without delay.

(a) *Searching.* At the earliest possible moment a responsible person should be contacted to ascertain how many people were in the building at the time of the outbreak and whether they have all been accounted for. The evidence of bystanders, and stories such as "I saw him jump out of a back window," particularly if only hearsay, should be treated with reserve. Evidence that everyone has actually escaped should be insisted upon before the search is abandoned. The Police may often be able to assist in this by mustering the occupants to find out whether anyone is missing.

If it is suspected that anyone is still in the building it is essential that it should be thoroughly searched at the earliest possible moment, as fire may spread very rapidly, and within a few minutes parts of a building which rapid search might have cleared may become involved by the spread of fire and therefore inaccessible.

Searching should be carried out methodically and on a definite system, which should be detailed by the officer in charge before the search is begun. The general rule to be followed is that searching should commence at the point of greatest danger, so that the searchers are nearest to fresh air and safety at the end of the search. In a multi-storey building the best plan will usually be to proceed straight to the top of the building and work down, one member of the crew taking each floor. When a fire occurs on an intermediate floor of a large building, it will be found in the majority of cases that persons caught above the fire proceed to the roof. In a single-storey building, the search should commence as close as possible to the fire and work away from it. If sufficient men are available, searching should always be carried out by men working in pairs.

It should be remembered that people trapped in fire or smoke, particularly children, often take refuge under beds or in cupboards, where they hope to escape the smoke and flames. Searching, therefore, should be painstakingly thorough, every room being investigated and no possible hiding place, however unlikely, omitted. Searching a smoke-logged room is not an easy task, and is unlikely to be successful unless it is carried out on a definite plan. The fireman should not attempt to dash in, or to rush upstairs

impetuously, for this will result in his losing his breath and being unable to endure thick smoke for so long a period as if he proceeds steadily. The methods of breaking in have already been dealt with (see Chapter 35). Having entered the room, the first act should be to feel behind the door, since persons overcome by smoke sometimes manage to reach the door but have then insufficient strength to open it. The two places in which persons who have been overcome by smoke are most commonly found are, in fact, behind a door and under a window.

Once inside the room, a complete circuit should be made (Fig. 1), keeping close to the wall, feeling under and on beds and opening and feeling inside cupboards, wardrobes, divans and below other articles of furniture. People have even been known to climb into baths and turn the water on in their efforts to escape from smoke, and no possible hiding place, however small, should be overlooked. If a complete circuit is made in this way there should be little danger of a victim being missed, but as a final precaution the room should be crossed diagonally to make sure that no one is lying in its centre.

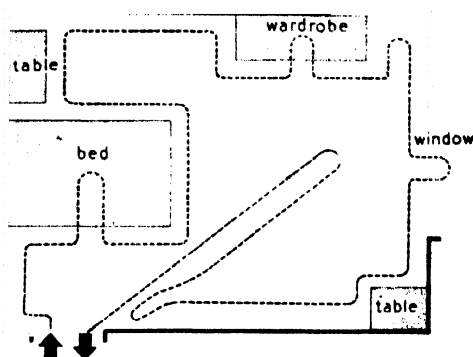


Fig. 1. Diagram showing correct method of searching a room.

Whether or not the fireman should open windows to obtain fresh air during his search will depend on conditions at the fire. If it is known that the fire is in a distant part of the building and is being tackled, or if the smoke is cool indicating this, it will be safe and desirable to open the windows. If, on the other hand, the seat of the fire has not been discovered and if the smoke is hot, denoting that the fire is not far away, then it is clear that windows should not be opened, since it would be undesirable to admit fresh air, which would provide oxygen and cause the fire to burn more fiercely.

The general principle should be borne in mind that once a fire is surrounded with branches in place, then ventilation is always right because it is desired that the fire should show up, so leading to early extinction.

It should be remembered that there are often cupboards on landings and under staircases and these also should be searched. Finally, if obstructions, such as boxes and trunks piled one on another, are encountered on a top landing, it may be assumed that persons have attempted to escape by way of a trapdoor to the roof, and the roof void should therefore be investigated.

(b) *Means of Escape.* Even though all the people in the building have been located, it may not be possible to rescue them immediately by ladders or other means, particularly if the fire has occurred in a factory or similar premises and large numbers of people have been trapped on the upper floors. In such circumstances, it should be remembered that roofs form one of the most convenient means of mass evacuation from burning premises, by enabling trapped persons to escape to another building, or to pass, *via* the roof, from the burning portion of the building to one which is not yet affected and to descend the staircase in that portion.

The fireman has unusual opportunities of going over large numbers of buildings of all types. He becomes familiar with the usual positions in which stairs are located and the means provided for escape, and develops a flair for deciding where they are likely to be found, even though he may never before have entered the building. Thus little time should be lost in searching for a secondary means of escape. It is almost impossible to overestimate the importance to a fireman of developing his powers of observation, and practising them at all times. It is valuable to observe such features as the type of window fastenings, the run of the stairway and the position of emergency exits when visiting buildings in his area. He can notice external escape staircases when walking about the town, and the knowledge of such exits may one day prove invaluable. At a hotel fire in a large city, for example, a Fire Service officer was able to save 25 lives by entering the building from a nearby roof *via* an emergency door of whose existence the occupants of the affected building were unaware, and subsequently escorting the trapped persons to safety by this route.

Many other means of emergency escape have been used in such circumstances. People have escaped from buildings or, when they have been agile and a number of persons have had to be rescued, have been shown how to escape, by climbing down stackpipes to a lower floor; by passing from one building to another by way of balconies, parapets, window ledges or other projections; by sliding down sunblinds; by descending to the basement (when the fire has affected portions of the ground floor containing the only exits) from which they were rescued by firemen who knocked a hole in the party wall between it and the basement of an adjoining house; and by other means too numerous to mention. It is often possible, for example, to escape by dropping from a window on to the roof of an outbuilding, such as a wash-house or projecting kitchen, and so reaching the ground, and it should not be forgotten that in blocks of old buildings the party walls frequently do not reach up to the roof, so that it is possible to pass from one house to another by way of the common roof void.

When dropping from such projecting parts of a building or from a first floor window it is essential to reduce the length of the drop as much as possible, by first lowering the body to the full extent of the arms. The correct way to do this is shown in Fig. 2. Care should be taken when dropping, to keep the feet slightly outwards, to prevent the toes from catching on the window sill below, or any

other projections. It is also advisable to note the construction of the roof of any outbuilding on which it is proposed to land, before dropping. It may be made of cement-asbestos or other easily broken material.

Occasionally in warehouse fires people have been rescued by use of the pulleys and rope which are frequently found fixed above the loopholes on each floor for the lowering of goods.

In general, getting people out of the building once they have been located, is largely a matter of common sense. They will in most cases only need to be assisted to safety, but will, of course, have to be carried if they are unconscious or injured. The orthodox method of picking up may sometimes be modified with effective results by placing the feet of the person to be lifted against a wall (Fig. 3) so that the body will not slide when it is lifted to its knees. Another useful method, particularly when dealing with a heavy person, is for the rescuer to lie down on the floor beside the body, manœuvre it upon his back, and then slowly raise himself to a standing position. If the person to be rescued is particularly heavy, however, it is usually preferable (since it is less arduous and thus leaves the rescuer greater reserves of strength to combat heat and smoke) to drag him out. Picking up will also be very difficult if the person is unclothed or only lightly clad, for the heat and fumes may make the flesh damp and greasy and extremely difficult to grasp.

A good way to drag an insensible person is to turn him on his back on the floor, tie his wrists together with a

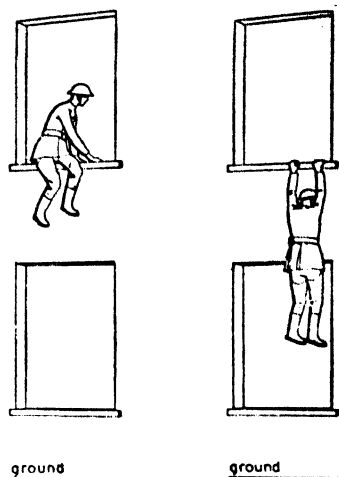


Fig. 2. Sketch showing one method of dropping from a first floor window.

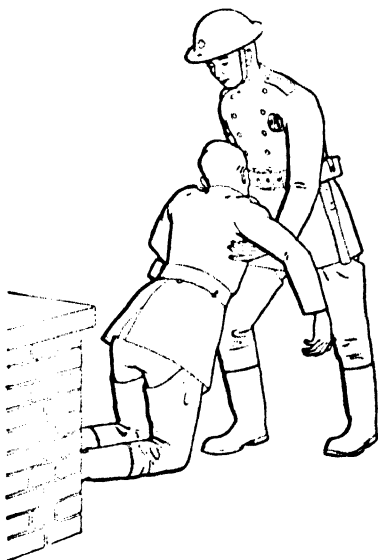


Fig. 3. Sketch showing one method of picking up an unconscious person by pinning him against a wall to prevent his body sliding as he is lifted.

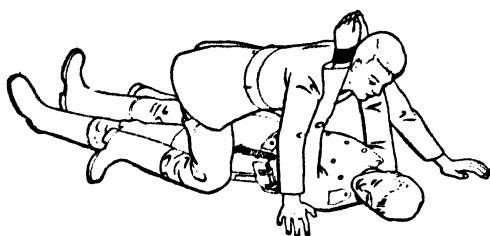


Fig. 4. Sketch showing method of dragging an unconscious person.

time. Stairs should be negotiated by laying the rescued person on his back, with his head pointing downstairs, holding him under the armpits and allowing him to slide gently down (Fig. 5).

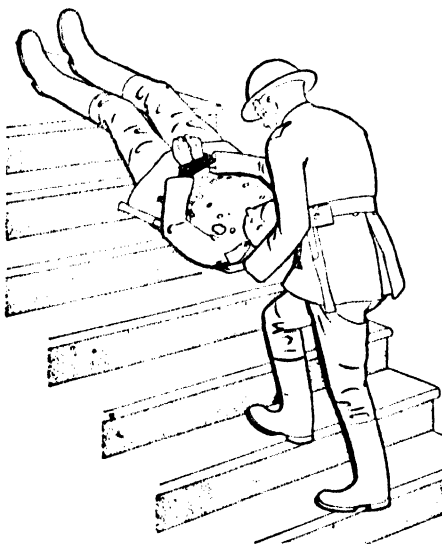


Fig. 5. Sketch showing method of dragging an unconscious person downstairs.

felt unaffected by the smoke to which they had been subjected, collapsed while making their way to safety, and such collapses can have fatal results if they occur in a smoke-laden atmosphere, or on an outside staircase or other dangerous position.

Persons who have been rescued from a fire in difficult circumstances, or who have sustained burns, will be suffering from shock, and every effort should be made to see that medical attention is forthcoming as soon as possible. Ordinarily an ambulance will be in attendance, but should this be delayed, the fireman must be prepared to take such first aid measures as are practicable in the circumstances. Suitable first aid treatment for shock, burns, fractures and hæmorrhage is outlined in any of the approved first

hardkerchief or belt line and kneel across him. If the rescuer's head is then placed through the loop formed by the tied hands (Fig. 4) it will be found comparatively easy to crawl on hands and knees, dragging the rescued person at the same

It should be remembered that one of the effects of fumes is to cause loss of judgment, and that people who have been trapped in smoke are in consequence often completely unaware that they have suffered any ill effects, and insist that they are perfectly capable of rescuing themselves. Such statements should never be relied upon, and all rescued persons should be assisted, or at least accompanied, from the building, if there is any doubt as to their condition. Many cases have occurred, in which people, who had stated that they

aid manuals. It should be remembered that the Police are trained in first aid and it may often be possible to hand the patient over to them.

(c) *Resuscitation.* There is one aspect which is peculiarly the function of the Fire Service, and that is the resuscitation of persons suffering from asphyxia. The methods of carrying out this treatment have been fully described in Chapter 12, and it should only be necessary here to emphasise that the Fire Service officer should never assume too hastily that a person rescued from a smoke-logged building, and apparently asphyxiated, is in fact dead. There have been several cases recorded of persons who had been given up for dead and laid aside to await the arrival of an ambulance, being revived by determined efforts on the part of a more experienced, or perhaps more persistent, officer arriving later at the fire. It is worth remembering that if no resuscitation apparatus is available, an oxygen breathing apparatus set can be used by disconnecting the supply tube from the breathing bag and using it to supply pure oxygen to the patient. Resuscitation in such circumstances will be assisted if a blanket or rug is placed over the patient's head, in order to concentrate the exhaled CO_2 and thus give the effect of using a resuscitation set (see Part 1, p. 221). Unless it is obvious from the nature of the injuries that the victim is dead and that the body will not be involved in any possible spread of the fire, all unconscious or apparently dead persons should be removed either to an unaffected part of the building or to an adjacent building. They should not be taken out into the open air and left, since it is essential that persons suffering from shock should be kept warm. There is always the possibility that life is not extinct and that suitable measures may result in the victim's resuscitation. This possibility is well summed up in the quotation on the medals of the Royal Humane Society which may be freely translated as "Peradventure a tiny spark may yet lie hid."

Where the fire situation permits, the attention of the Police should be drawn to any body in which life is obviously extinct, and in consultation with them a decision should be reached as to whether it should be removed. Victims may be removed in a body sheet, blanket, jumping sheet, tarpaulin or salvage sheet.

3. STRAIGHTFORWARD LADDER RESCUES

Ladder rescues fall into two distinct categories—those in which the ladder is used solely as a means of access to a building or to a nearby roof, the rescue itself being then carried out by other means; and those in which a ladder is pitched to some part of the building and used in effect simply as a substitute for a staircase, the rescued persons being either assisted or carried down to safety.

There are five special types of ladder used in the Fire Service. Each has its own particular function and method of use, and it is proposed, therefore, in the first place, to deal briefly with the straightforward use of each type, leaving the more complicated methods of rescue, such as bridging, to be dealt with later. The height which can be reached by the various types of ladder is shown

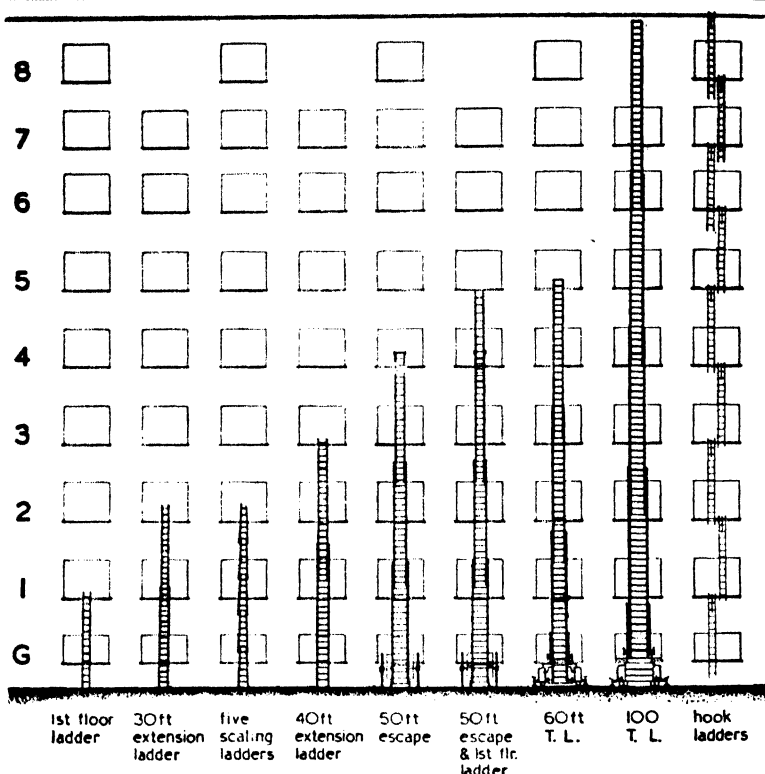


Fig. 6. Diagrams showing the heights and floors reached by the various types of ladder (the floor levels of buildings differ considerably, according to the type of construction, but the distances shown in the sketch may be taken as an approximate indication for rough calculations on the fireground).

diagrammatically in Fig. 6, in order to give an approximate idea of which floor of a building can be reached with each type.

The use of ladders has been described in Chapters 6, 16 and 17 and in the various escape, turntable and other ladder drills in the N.F.S Drill Book; and every fireman should be thoroughly conversant with the methods of operating the various types. All that is necessary here, therefore, is to give a brief account of the application of each ladder to rescue work.

The most important thing in every rescue job is speed. Even a few seconds wasted in getting a ladder into position may easily result in loss of life, either because the victim jumps, or because there are several persons to be rescued and only a limited time in which to work before conditions become impossible.

When the ladder (whatever its type) has been pitched, no time should be lost in getting the trapped persons on to it. If they are capable, they may be allowed to make their own way down, but a fireman should always go down immediately below them. He

should, as far as possible, so descend that, should they collapse whilst they are on the ladder, he can pin them against it until help arrives.

(a) *Escapes.* The wheeled escape is the principal rescue appliance of the Fire Service in this country. Escape work demonstrates very clearly the principal justification for insistence on regular drills, since in no other way could the necessary speed and precision in an emergency be achieved.

If, on arrival at a fire, persons are seen at upper windows calling for help, an escape should always be used, where access conditions permit, because of the speed with which it can be brought into operation. As soon as it is in position, two members of the crew should mount and effect an entry into the building. In the standard drill this is carried out by numbers 3 and 4 and, since great physical strain may be involved, it is usual to arrange that these places are taken by the youngest and most active members of the crew.

It is sometimes almost impossible (e.g., when there is a very small clearance in the window) for one man to get an unconscious person on to an escape alone, and it is therefore essential that two men should be available. The circumstances of the particular rescue will dictate the action to be taken, but if, for any reason, it is impossible to pick up the rescued person in the normal way and step on to the ladder, it may be possible for one man to enter the building and pass the rescued person out on to the shoulders of the other man at the head of the escape. The normal method of stepping on to an escape when carrying down is described and illustrated in Part 2, p. 106, where other information on the use of escapes will also be found. If unusual difficulty is anticipated in getting a rescued person on to an escape or other ladder, it is always advisable to resort to lowering (see later).

When carrying an unconscious person down an escape it is important to step slowly and carefully, always moving the same hand and foot together, and particular care must be taken to prevent the feet or head of the rescued person riding over the guy wires. It is easy to forget such things in the excitement of the moment and if the person is very heavy it will not take much to dislodge him from the rescuer's back. Some ex-regular escapes are fitted with detachable guy wires (see Part 2, p. 103), which can be released by means of spring hooks, to facilitate carrying down.

It should also be remembered that when stepping off the escape on to the ground when the rescued person's head is over the rescuer's left shoulder, one should normally step off to the right and then turn left about immediately. This will obviate any possibility of the rescued person's head striking the large escape wheel.

Where several rescues must be carried out, it is essential to control the number of persons on the escape. Normally more than one person at a time should not be allowed on each extension except, of course, when carrying or assisting down and at the moment when the rescue is being effected, at which time there will frequently be two firemen together on the top extension.

It is often extremely difficult, owing to the smoke and heat

issuing either from the window to which the escape is pitched or from one immediately below it, for the fireman to effect an initial entry. There are three points to remember in such cases :

(i) The ladder should always be pitched to the windward side of the window, so that smoke and flames are blown away from the rescuer.

(ii) A diffuser or other spray branch at low pressure should be directed on to or near the fireman. It will not only help to cool him and save him from the worst effects of heat and flames, but will also provide a breathable atmosphere in his immediate vicinity.

(iii) If some time is taken to effect an entry, *e.g.*, if heavy metal bars have to be removed or if, owing to the great heat, several attempts have to be made before a successful entry is achieved, the man at the head of the ladder should be relieved. A short period of such work is exhausting, and a man who is fresh may succeed where his predecessor failed owing to exhaustion caused by his initial efforts.

A considerable proportion of buildings in our larger towns and cities are now of five or six storeys, and it frequently happens that the wheeled escape will not reach to the necessary height even at maximum extension. A turntable ladder, if available, should, of course, be used in such cases. If no turntable ladder is immediately available, however, a secondary ladder (either a hook or a first-floor ladder with claws) may be taken up an escape and pitched from its head. The methods of carrying out these operations were described in Chapter 16. In all cases when a fireman enters a building by means of an escape or a turntable ladder he should take a line with him, not only because it may be necessary for rescue work but also to ensure his own safety. It is the usual practice in escape work for the second man up to take a line with him as a matter of routine.

(b) *Extension Ladders.* Although the escape is the ideal rescue appliance, there are occasions when it cannot be used, either because the street is too narrow or because railings or areas make it impossible to get an escape sufficiently close to the building. In such circumstances it may be permissible in an emergency either to remove one of the gate pillars or effect a breach in the wall of sufficient size to permit the passage of the escape. Escapes can rarely be used at the rear of a building in a crowded city area, for houses back on to each other and are often separated only by narrow enclosed yards. In the majority of such cases an extension ladder should be employed, since it can be pitched in a confined space and can also, if necessary, be carried through a building or manhandled over a rear wall for use at the back of the building.

The correct method of pitching an extension ladder is given in the N.F.S. Drill Book. If the ladder is likely to be used for an extended period (*i.e.*, if a number of persons have to be either assisted or carried down), two ladders should be pitched side by side and the strings lashed together to provide greater stability. The head of an extension ladder should also, whenever possible, be lashed to some suitable object by means of a line (the escape line can be used if one is fitted) before it is used for rescue work.

If there is no convenient object to which the head can be lashed the pick end of a small axe driven firmly into the window sill will give reasonable security.

Short extension ladders, or the divided sections of long extension ladders, are valuable for use inside buildings as a substitute for a damaged staircase and to provide access to the roof through skylights, etc.

(c) *Hook Ladders.* Situations may sometimes arise where only a hook ladder can be employed, although comparatively few rescues have been achieved directly by their use. The sight of a fireman climbing the building towards them is always reassuring to persons trapped on upper floors, and even though their rescue may not finally depend on the hook ladder, its use will, in many cases, prevent them jumping. If, therefore, it seems likely that there will be any difficulty in getting an escape or other ladder pitched, an experienced officer will frequently send men up the building by hook ladders, although there may appear little likelihood of the rescue being effected by this means.

Rescues have, of course, been effected in the past directly by hook ladders, and there is even one case on record of a fireman carrying an unconscious person down a hook ladder. When, for example, the construction of a building makes it impossible for an escape or turntable ladder to be pitched directly to the floor where the persons are trapped, a hook ladder or ladders may be used to link the head of the escape with the point at which the persons are waiting.

Almost invariably the rescued person, when reached by a hook ladder climb, should be lowered down by line (see later). A man should never be permitted to go up a hook ladder without a line; this is often carried on the back in a special sling, but if this is not available one or other of the methods of making up a line described in Chapter 39 should be employed. Not only will a line then be available for any rescue operations but it will also ensure the fireman's own safety—as, for example, if the ladder should be burnt by flames suddenly breaking from a lower window.

The hook ladder finds one of its principal uses in enabling the fireman to reach persons trapped temporarily on the upper floor of a building by the smoke from a fire on a lower floor. Once a fireman has reached people in this way, he should remain with them until all danger is passed, since the moral effect of his seeming to desert them would be disastrous.

The hook ladder is also valuable for effecting access to buildings. It may often be possible, for example, for a fireman to reach an unaffected part of a building by means of a hook ladder, thereafter reaching the upper floors by way of a staircase. If a projecting cornice prevents an escape or extension ladder from being pitched beyond, say, the second or third floors of a building, a hook ladder can be carried up the escape, taken into the building and carried up inside to the floor above, when the ascent can be continued. Alternatively, it could be taken through to the back of the building and the ascent continued up the rear windows. Similarly, a hook ladder may be taken up inside a building, or passed down from an

adjoining building, to enable trapped persons to make their way to safety by way of adjacent roofs. Again, when the front of the building is difficult to approach, and rescue work has to be carried out at the back, the hook ladder will be found invaluable for getting over garden walls and surmounting projecting sheds and offices.

(d) *Turntable Ladders.* The turntable ladder, when it can be got to work, is of particular value in large scale rescues and, when many people have to be rescued from one place (from the roof of a building, for example), this appliance should always be used, owing to the greater number of people who can be permitted upon it at one time. Moreover, the trussing gives the impression of a handrail and enables many people who might otherwise have to be carried or assisted down to make their own way to safety. At a recent hotel fire, for example, 12 persons were rescued by means of a turntable ladder in

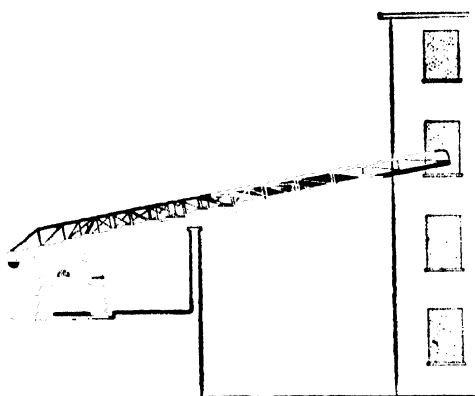


Fig. 7. Sketch showing method of effecting a rescue by bridging with a turntable ladder when difficulty of access makes it impossible to get an escape across to the building.

a very few minutes. It should also be remembered that a turntable ladder can be used to span horizontal distances of a very much greater order than can be attempted with an escape, and if an obstruction prevents an escape being pitched near to the building it may often be quicker to use a turntable ladder (Fig. 7). When using a turntable ladder in this way care must be taken to see that the safe work-

ing limit is not exceeded (see Part 2, p. 143).

In many large towns both an escape and a turntable ladder form part of the first attendance at all fires. It frequently happens that persons may require to be rescued from windows at different levels, and if an escape is used alone it has to be lowered, moved and repitched to effect each individual rescue. In such circumstances, since an escape can be got to work more quickly, the obvious course is for the escape to be used to rescue those persons who are in the most immediate danger, while the turntable ladder is being pitched to the other window or windows.

Instructions on the use of turntable ladders for rescue work were given in Chapter 17.

(e) *Scaling Ladders.* Scaling ladders, though seldom used for a direct rescue of persons from a building, are useful for work inside buildings or in confined spaces, on account of their short length. Several lengths of scaling ladder can be joined together (see Part 1, p. 110) and five (which is the maximum) will then reach to a height

of 29 ft. Their use for bridging has been dealt with in Part 1, p. 111. Only in emergency should an unconscious person be taken across a bridged ladder. The safest procedure, when a bridged ladder has been used by a fireman to reach the affected building, is for the rescued person to be lowered by line and drawn across the gap by means of a guy line.

Scaling ladders can also be used as improvised stretchers, both for carrying injured persons from buildings and for lowering when the rescued person is too seriously injured to permit the use of lines or slings. The method of lowering a scaling ladder used as a stretcher (Fig. 8) is as follows :—

A bowline on the bight, or a chair knot, should be tied in a lowering line or long line. The two bights should be of equal length and when

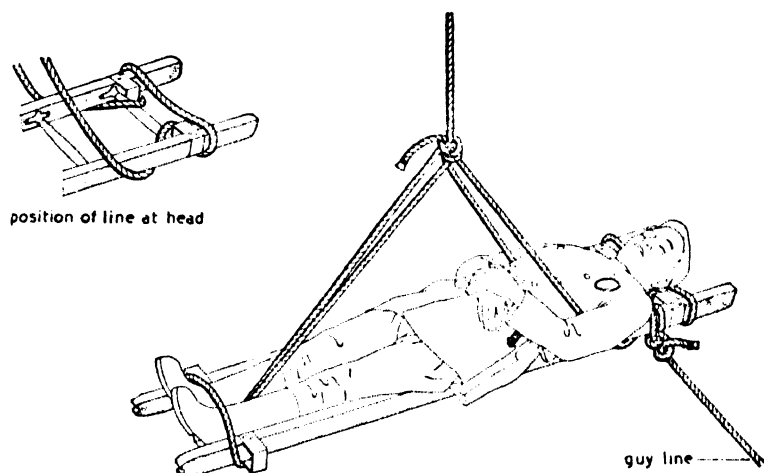


Fig. 8. Sketch showing use of scaling ladder as an improvised stretcher for lowering an unconscious person. Above : detail of heel of ladder, showing method of securing the bight.

spread out the total length should be $1\frac{1}{2}$ times that of the ladder. The heel of the ladder should then be passed through one bight and the centre of the bight brought up between the bottom two rounds, passed over the bottom round, and then under and around the ends of the two strings. The line should then be adjusted across the top of the strings to form a rest for the patient's head (Fig. 8, above). A lowering line with running eyes (see Part 1, p. 123) can be used for the same purpose.

The person to be lowered is then laid on the ladder with his head toward the wide end (the heel) and the bight arranged (Fig. 8), to pass under each armpit. The other bight is passed down between the victim's legs through the fifth and sixth rounds of the ladder and then brought up outside the strings so as to imprison the feet. If necessary, the relative lengths of the two bights must be adjusted so that, when the ladder is lowered, the head is kept

higher than the feet. If a lowering line with running eyes is used, the head is kept higher by using the shorter leg for the head. Padding should be placed in position as circumstances permit, to prevent the line chafing or injuring the body, and a guy line should be attached to a string of the ladder between the first and second rounds. This method of attachment ensures that the ladder cannot rotate and that the heel of the ladder (*i.e.*, the rescued person's head) is kept away from the building by those pulling from below. The ladder is then lowered out of the window or from the roof. The guy line is cast out to a member of the crew waiting below who hauls on it to keep the ladder clear of the building. If the line is being used in conjunction with an escape, it should be led over a convenient round, a round turn being taken on the crossbar at the top of the ladders.

In some localities special slings are used for lowering, both as a substitute for the running eyes at the end of a lowering line and

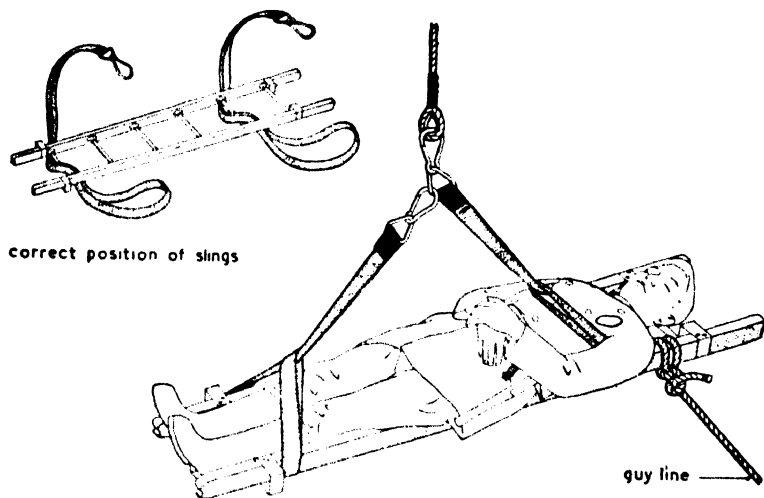


Fig. 9. Sketch showing use of slings in conjunction with a scaling ladder used as a stretcher. Above: detail showing correct position for slings before body is laid on ladder. Note: The slings would, of course, be drawn taut in use. They have been opened out in the drawing for the sake of clarity.

when using a scaling ladder as a stretcher. The slings (Fig. 9) are in the form of a bight, some 4 ft. 9 ins. long and approximately 3 ins. wide, and are made from stout webbing. A leather binding strap at one end serves to secure a steel fitting, consisting of a triangle and a spring hook which is made integral with the triangle, so that it has freedom of movement but will assume a natural position at the apex of the triangle when it takes the strain. The triangle thus acts as a kind of universal joint, allowing more latitude to the hook than would be possible if it were bent directly on to the sling. It is also used for clipping two slings together.

When using these slings for lowering with a scaling ladder

as a stretcher, two slings are employed, the procedure being as follows :

(i) The body is laid on the ladder in the normal manner with the feet towards the head of the ladder.

(ii) The first sling is passed under the string between the first and second rounds ; over the second round ; and under the string again on the opposite side of the ladder (Fig. 9, *above*). The bight is then brought up over the body, opened, and the hook passed through it to form a strop which is drawn tight round the chest. Care should be taken to ensure that, when the sling is drawn tight, the hook is in the centre of the body.

(iii) The second sling is passed under the string between the fifth and sixth rounds ; over the sixth round ; and under the string again on the opposite side of the ladder (Fig. 9, *above*) and then drawn tight round the ankles.

(iv) The hook of this second sling is then clipped to the triangle of the first sling and the result is a position similar to that achieved by the use of a lowering line with the exception that the body remains almost horizontal (since both slings are of equal length). The head is, however, kept slightly higher owing to the greater width of the ladder at this point and the difference in thickness between the chest and the legs, which have the effect of shortening the length of the bights made by the sling.

(v) A guy line should be bent on to the ladder string in the manner described above.

(vi) The lowering line is then attached by clipping the hook of the first sling on to a thimble or second hook provided on the line.

(f) *Other Ladders.* It will sometimes be found, on arrival at a rescue job, that members of the public have already begun to assist people from the building, using builders' or other ladders which may have been handy. It will then be necessary to decide whether or not the use of these ladders should be continued. This decision will obviously depend largely on the circumstances of the individual case, but, in general, every effort should be made to get Fire Service equipment into use as soon as possible. Firemen have been injured by using such ladders, which are frequently in poor condition and were in any case not designed to take the great strain imposed on a ladder by carrying down.

4. BRIDGING AND OTHER USES OF LADDERS

The function of a ladder is to allow the fireman to reach persons who may be trapped in positions from which they cannot be reached by the staircase. It will not infrequently arise, therefore, that ladders will have to be used in unusual ways, and the well trained fireman, having a sound knowledge of his equipment, will know its capabilities and its limitations. Nowhere is the ability to improvise at short notice more necessary than in handling ladders, and their efficient use will enable the fireman to reach trapped persons who might otherwise lose their lives.

Ladders of different types will frequently be used in conjunction with one another. Thus a hook ladder or small extension ladder can be taken up the escape or long extension ladder and the climb continued; or scaling ladders can be taken up and used to bridge across a horizontal gap. The extending part of a long extension ladder can in some types be unshipped and carried up. A ladder chain is illustrated in Fig. 10 to give an idea of how the various types might be used, though it should be appreciated that it would be most unusual to employ such an arrangement in practice.

Ladders may also be used for bridging, either to span a horizontal gap between two buildings, or parts of the same building, or to cross an intervening stretch of water such as a canal.

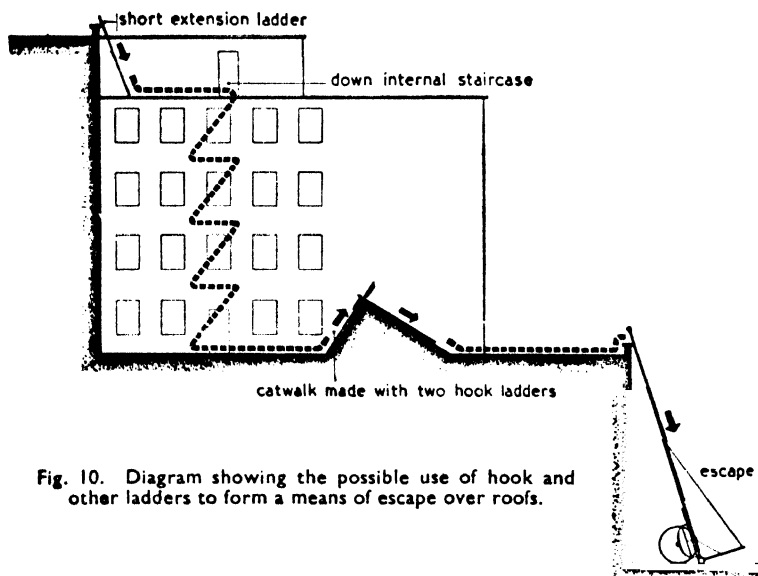


Fig. 10. Diagram showing the possible use of hook and other ladders to form a means of escape over roofs.

If a ladder is to be used in this way, it may, if the distance is small, be got across by pushing it, keeping the weight well on the heel. If the distance is too great for this to be done, then it will usually be more satisfactory to secure a short line to the round at the head of the ladder, elevate it and, keeping the heel steady, lower it across by means of the line (Fig. 11). Alternatively, if an extension ladder is used, it may be possible to bridge the gap by extending the ladder as shown in Fig. 12. If an extension ladder is used it is advisable (as an additional precaution) to lash the two sections together after extending.

Ladders were used for bridging, for example, at a large hotel fire to reach persons trapped at the foot of a light well. They have also been used at ground level to enable firemen to gain access to the rear of premises backing on to a canal.

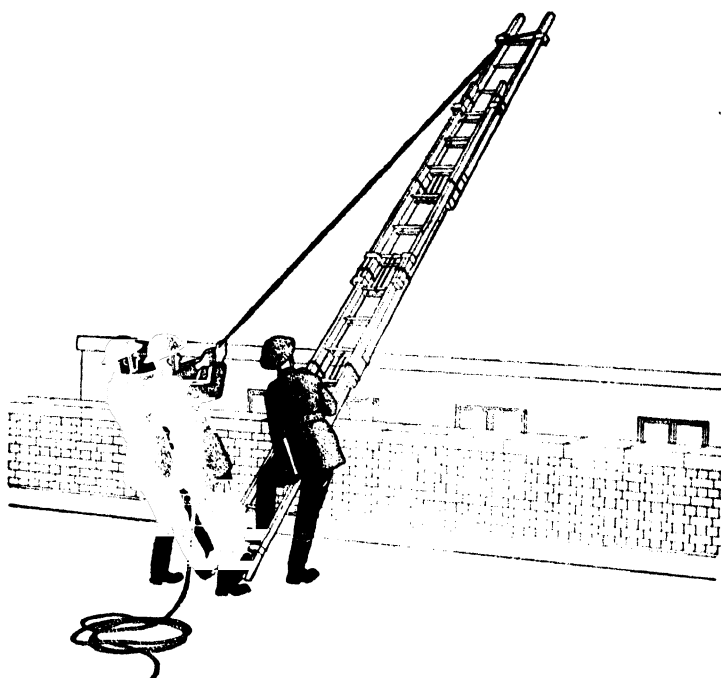


Fig. 11. Sketch showing one method of using scaling ladders for bridging.

The distance which ladders should be used to span will depend on the type of ladder, and must be carefully controlled. If a ladder is being used near the limit, or in dangerous circumstances, it is always wise to secure a line to the person using it and to take a turn with the other end around some firm object, which could take the strain in the event of an accident.

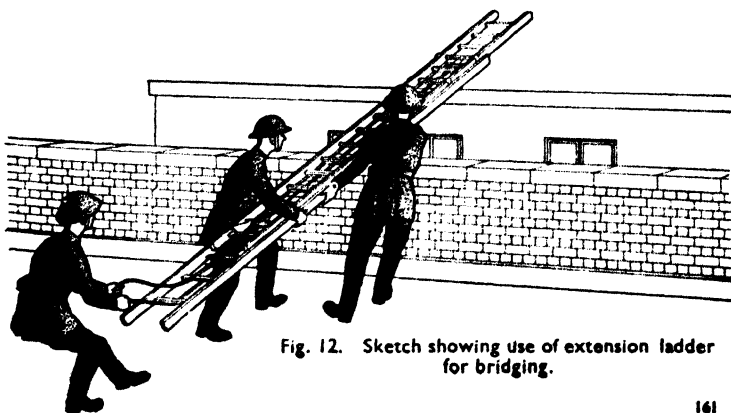


Fig. 12. Sketch showing use of extension ladder for bridging.

5. LOWERING

Even when trapped persons have been reached by the use of a ladder, it will often be necessary to lower them down by a line. If a hook ladder has been used, the rescue must usually be effected by lowering; but there are also cases, even when an escape has been used, in which lowering is necessary. Very heavy persons cannot be carried down, except by a phenomenally strong man, and if there is any doubt in the matter, it is advisable to resort to lowering, rather than run any risk of the rescuer getting into difficulties when halfway down the ladder. (In some American fire brigades there is a rule that carrying down should not be attempted if the person to be rescued is estimated to weigh more than 16 stone.) It is thus essential in any rescue operation to have a line handy.

The technique of lowering is more a matter for practical drill than for verbal description, but the following notes may be of value.

(a) A lowering line with running eyes (see Part 1, p. 123) should be used, if available, since it obviates the necessity for making a knot. The standing or shorter part—which is indicated by a Turk's head knot (see Chapter 39)—should be placed under the person's armpits and the longer part to grip at the knees (Fig. 13).

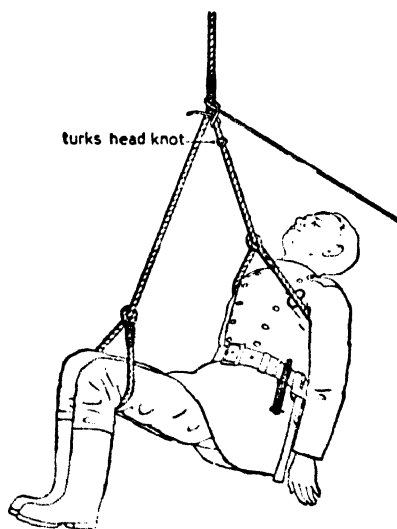


Fig. 13. Sketch showing method of placing an unconscious person in a lowering line with running eyes.

It is essential that the shorter part should be employed in this position, since not only will the head thus be kept upright but also, should the splice draw, the person being lowered will still be held securely by the standing part. The guy line, which should be attached by means of a clove hitch, one part of which is made above and the other below the splice on the standing part, should then be thrown down, so that the men below can haul on it to keep the body clear of the building.

(b) If a lowering line is not available, a long line should be used, a chair knot or a bowline on the bight (see Chapter 39) being made either at one end or in the middle of the line. If the distance the person has to be lowered is

less than 40 ft. it is better to make the knot in the middle of the line, since one end can then be thrown down to form a guy line. If the distance is greater than 40 ft., a second line should, if possible, be secured and bent on to the rescue line immediately above the knot by means of a round turn and two half hitches so as to form a guy line.

(c) When lowering by line in this way, the rope should never be allowed to run through the hands, but should always either be lowered hand over hand or passed round a convenient object. Care should be taken not to pay out too fast, and a steady even rate should be maintained, in order to limit the friction at the point where the rope passes over the window sill or parapet. If the rescue is being effected in conjunction with an escape, the line should be led over a convenient round and the end thrown down, paying out being effected from ground level (in the same way as with a turntable ladder), a round turn being put on the crossbar at the top of the levers to check the rate of descent. Some escapes are fitted with a rolling round at the head to reduce the friction on the line as it is paid out.

(d) When selecting the position from which to lower, it should be remembered that it is better to lead the line over wood (e.g., a wooden window sill) if possible, rather than stone, as there is then less risk of the rope being frayed. There is always a danger of chafing during lowering, and every effort should be made, both by care in the selection of the point over which the rope is led, and by avoiding paying out too fast, to prevent this occurring. If time permits, some padding, such as a sack or a small mat, should be placed under the line where it passes over the sill.

(e) If only one man is available to carry out the lowering, and there is no suitable object about which a round turn can be made, it should be effected as shown in Fig. 14. The man should stand at right angles to the window and the line should be led down from the sill to the floor and taken under the instep of the left foot, being then paid out as required by the right hand. The left foot should be against the wall. The left leg must be kept rigid and the knee well braced back. If the knee is allowed to bend, the strain on the line will cause it to give, and control of the line will then be lost. The body, in effect, acts as a fulcrum and the aim should therefore be to keep it as rigid as possible, the left arm on the sill being used to assist. Owing to the fact that if control of the line is lost the person being rescued will fall to the ground, this

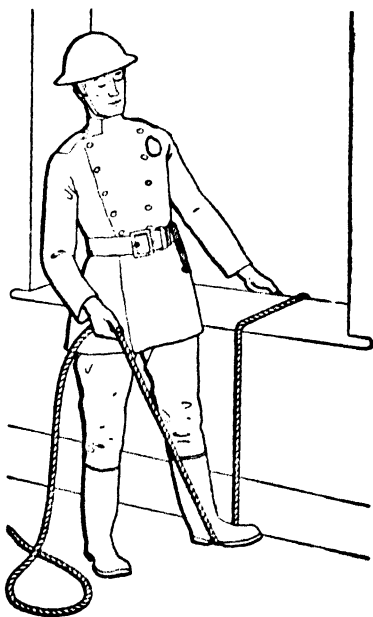


Fig. 14. Sketch showing a method of lowering, when this is effected by one man only.

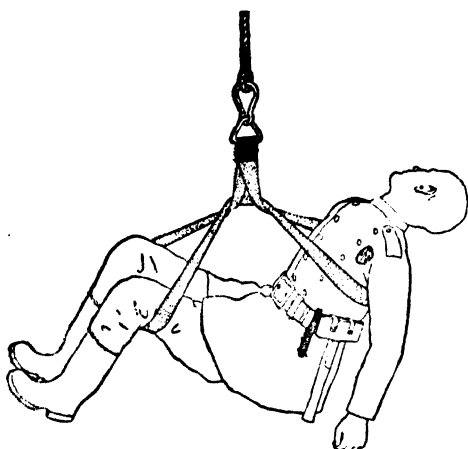


Fig. 15. Sketch showing use of sling for lowering.

the armpits. The end of the sling is then passed through the bight on the other side of the body, thus forming a strop, and the whole drawn tight. The lowering line is then clipped on and lowering carried out as described above. An alternative method of using a sling of this type for lowering is shown in Fig. 16.



Fig. 16. Sketch showing alternative method of using a sling for lowering.

method should only be used as a last resort.

(f) A long line fitted with a spring hook or a thimble bent on to one end can also be used for lowering in conjunction with a sling of the type described on p. 158. One sling only is used (Fig. 15), the bight being opened and the person to be rescued placed in it so that one part is beneath the back of the knees and the other under

(g) Lowering can also be effected with the assistance of a turntable ladder. The method of carrying out this operation is described in Chapter 17.

(h) Several other items of gear have been produced with the object of checking the speed at which the rope is paid out. Typical of these is the brake block described in Part 1, p. 235. Such devices, however, introduce an added complication in that the device itself must be bent on to a stable object before lowering, and it is not always easy to find such an object. They are not issued to the National Fire Service.

6. AUTOMATIC ESCAPES

The automatic escape consists essentially of a steel cable covered with cotton or canvas belt braid and fitted at each end with a webbing sling, which is tightened as required by means of a metal clip. The cable passes over, and rotates, a drum which incorporates a friction brake so that the speed of rotation, and hence the rate at which the cable can pass over the drum, is automatically maintained at a previously determined speed of from 2 to 4 ft. per second. The

length of cable is varied according to the requirements of the purchaser, and may range from 15 ft. to any desired length.

The operation of the two principal types of automatic escape is shown diagrammatically in Fig. 17. In the Davy type (Fig. 17, *left*) the line passes round a pulley (*a*) mounted on a plate (*b*) which is free to rotate on a central axis (*c*). Two gears (*d*) are secured to the plate (*b*) and engage with an internally geared ring (*e*), so that they are driven round by it when the plate (*b*) is rotated. A central gear (*f*) mounted co-axially with, but not rotating with, the pulley (*a*) and plate (*b*), engages with the gears (*d*). Movement of the

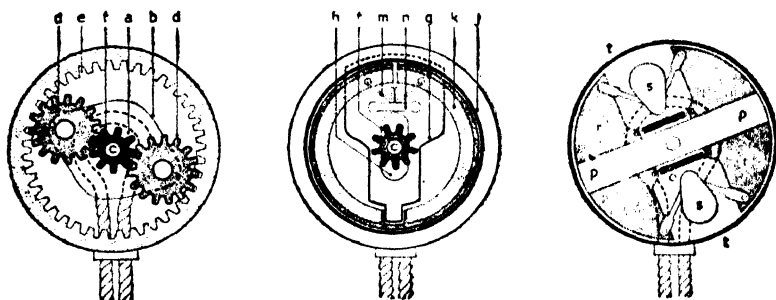


Fig. 17. Diagrams showing the operation of the two principal types of automatic escape. Left and centre : Davy. Right : Longworth.

line in either direction rotates the pulley (*a*) and hence the plate (*b*) which, in turn, causes rotation of the gears (*d*) and (*f*). It will be seen that the effect of this chain of gears is to step up the rotation of the central gear (*f*) in relation to that of the pulley (*a*), the ratio being in the region of four to one.

Mounted above the gear (*f*) and rotating with it, is a frame carrying a governor weight (*g*) (Fig. 17, *centre*) which is free to move laterally on the slot (*h*). The upper part of the escape casing comprises a brake drum containing a fibre lining (*j*) and a divided brake-shoe (*k*). Two arms (*m*), which engage with a projection (*n*) on the governor weight, are attached to the shoe. When the gear (*f*) is rotated, the governor weight tends to slide outwards under the influence of centrifugal force, and the pressure of the projection (*n*) on the two arms (*m*) causes the shoe to expand and thus produce a braking action, which increases in force with the speed of rotation. It will thus be seen that if the line is drawn slowly through the drum there is little or no braking action, but as soon as the speed increases (as when the weight of a person is applied to it for descending) the brake comes into action.

The design of the Longworth automatic escape is based on the same operating principles and employs the braking effect of a pair of shoes thrown against a drum by the action of centrifugal force. The design of the speed-increasing gearing is very similar to that used for the Davy automatic escape, but the geared ring (*e*) (Fig. 17,

left) is integral with the pulley over which the cable passes and rotates with it. Through two planet wheels which are mounted on a fixed base but which are free to rotate, a central gear is driven at approximately $5\frac{1}{2}$ times the speed of the cable pulley. This central gear is rigidly connected to a transverse bar (*p*) (Fig. 17, right) on each side of which brake-shoes (*r*) are mounted, in such a way that they are free to slide laterally. Governor weights (*s*) are carried on arms between the two brake-shoes. When the pulley is rotated the governor weights tend to move outwards under the

influence of centrifugal force, thus forcing the brake-shoes against the drum (*t*).

The automatic escape consists of two principal parts (Fig. 18), the braking mechanism, which is usually provided with an eye ring and spring hook (similar to that used on a loose link type hook belt) for clipping on to a fixed eye screwed into the wall of the building near a window, or any other suitable object, and the cable reel on which the cable is wound. Operation is as follows:—

(a) The braking mechanism is clipped into position or otherwise secured.

(b) The sling, which will be found wound on the outside of the reel, is then uncoiled and the reel cast down (Fig. 19 (i)), care being taken to ensure that the cable unrolls satisfactorily.

(c) The sling is then drawn over the head of the person to be lowered (Fig. 19 (ii)), secured under the armpits and adjusted as necessary by means of the steel slide. The cable leading to the ground is then pulled until the sling is drawn tight. If the sling is not drawn up tight in this manner there will be an uncontrolled drop of some feet before the braking mechanism comes into operation.

(d) The rescued person then sits on the window sill (Fig. 19 (iii)) and when he is ready pushes himself off with his hands, and the automatic mechanism controls the speed of descent (Fig. 19 (iv)).

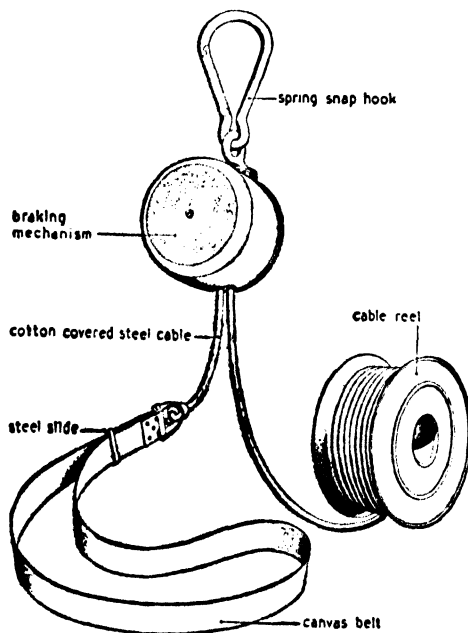


Fig. 18. Sketch showing constituent parts of typical automatic escape.

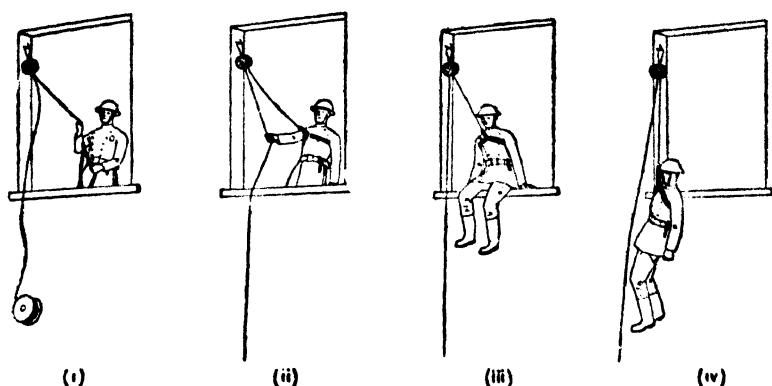


Fig. 19. Sketches showing use of automatic escape : (i) throwing down the reel ; (ii) sling drawn over head and cable tightened ; (iii) sitting on sill prior to jumping ; (iv) descending.

No attempt should be made to control the speed of descent by grasping the ascending cable.

(e) The part of the cable which was thrown down will ascend as the rescued person descends and, with a fixed installation, by the time he has reached the ground the second sling at the other end of the line will be available for another person to descend. If the same automatic escape is used from positions at different heights the second sling may not return exactly to the window, in which case the excess cable should be drawn through as shown in Fig. 19 (ii) until the sling is within reach. It is important to remember that the sling should be drawn tight (as described in (c) above) on each occasion.

These devices are regarded by the Fire Service as emergency appliances and will not normally be used if Service equipment is available. When lowering from a turntable ladder, for example, the standard rescue equipment described in Part 2, p. 154, should be employed. The description given above has been included since the use of these appliances is fairly general and the fireman should certainly be familiar with them.

The following points should be noted when an automatic escape is examined :—

(i) *A Davy automatic escape should never under any circumstances be oiled*, since special non-metallic bearings are provided and any oil which might reach the braking surface would reduce the braking effect. On the other hand a lubrication system for the central axle is provided in the Longworth automatic escape, but it is emphasised that excessive lubrication is to be avoided for the same reason. Longworth automatic escapes are lubricated before they are sent out from the works, and lubrication is only necessary at long intervals. The method of lubrication is as follows :—

The centre axle on which the mechanism revolves is bored to a depth of 2 ins., and two small grease holes are drilled in it which correspond with recesses in the bearings. When the cover protecting

the mechanism is removed this hollow shaft is exposed and should be packed lightly with grease (not oil) under finger pressure. When the cover is replaced, and the central screw inserted, the grease is driven into the bearings.

(ii) The cable should be carefully examined for any signs of swelling, since this is an indication of possible defects in the cable.

(iii) The rivets of the sling should be examined to ensure that they have not been weakened by rust.

(iv) Care should be exercised when using an automatic escape in conjunction with a turntable ladder, for there is always a possibility that the ascending portion of the cable, which hangs freely throughout the operation, may become entangled in the ladder should the latter have to be operated suddenly, as for instance to swing the rescued person away from the building to avoid heat or smoke. The ascending cable should always be watched, even when the escape is being used from a permanent fastening on a building, to ensure that its loose end does not become entangled with any projections.

7. THE JUMPING SHEET

Considerable differences of opinion exist as to the merits of the jumping sheet (see Part 1, p. 234) as an item of rescue equipment, and its use in the National Fire Service is being abandoned. In favour of the use of the sheet is the fact that persons in an extreme state of excitement due to a fire are likely to jump from the building and the Fire Service should therefore provide equipment to meet this contingency. Against this argument may be set the following disadvantages :—

(i) The jumping sheet requires a number of people (at least twelve) to hold it, and as this number will not normally be available from the crew of the first appliance to attend, bystanders (if any are present) must be used.

(ii) To use the sheet effectively requires a considerable amount of training, both of those who hold it and those who jump. This the person to be rescued will not have had.

(iii) The height of a safe jump is limited to round about 30 ft., and, even for this, bedding, etc., should be placed under the sheet in case it should yield sufficiently for the person jumping to strike the ground.

It is, of course, obviously impracticable for any instructions as to the method of jumping to be given to persons being rescued, but the information as to the correct method is set out below as a matter of interest, and may be of value if, for any reason, the fireman himself has to make a jump. Practice jumping is not permitted in the National Fire Service owing to the possibility of men sustaining injury.

The correct method of using a jumping sheet is as follows :—

(i) The sheet should be removed from the appliance and placed on the ground.

(ii) The sheet should then be opened by grasping the becketts and pulling them outwards.

(iii) At least twelve men should take up positions round the sheet, each man holding two adjacent beackets, one in each hand. The correct position is with the arms outstretched and palms downwards. The sheet should be held close to the building, that is to say the inner man should have his back as nearly as possible against the building. This will bring the centre of the sheet into its correct position some 6 to 7 ft. away from the building.

(iv) The men holding the sheet should then lean back with their bodies and heads held rigid and their feet together, so that they are supported by the sheet.

(v) When the officer in charge sees that the sheet is securely held he should give the signal to the trapped person to step off, calling out "*Taut Sheet*" as he does so, to warn the men holding the sheet. The men holding the sheet should not look upwards but should stare straight ahead. If they look upwards there is a danger that the sudden jerk when the man strikes the sheet may injure their necks.

The man jumping should stand on the window sill at attention with hands downwards. It is advisable to grasp the seam of the trousers with the hands to keep them in correct position during falling. He should look straight ahead at his own eye level and, at no time until he has landed in the sheet, should he look either upwards or downwards. When he is ready to jump he should step off (not jump) with the left foot. He should remain in the upright position during falling and should land on the balls of his feet, not flat footed. At the moment of impact he should allow his knees to bend. If the man looks into the sheet at the moment of impact he is likely to fall forward on his face.

8. METHODS OF SELF-RESCUE BY LINE

It may arise that a fireman finds that his escape has been cut off by the spread of fire. When operating under difficult or dangerous conditions, the fireman should always have a line with him. It is then a comparatively simple matter to make this fast over a window frame or to a bed or other piece of furniture drawn across the window, and then go down the rope hand over hand, gripping with the knees at the same time (Fig. 20). Sliding down should never be attempted, as the hands may be burned so severely in the process that it is impossible to retain a grip on the rope. If the fireman is wearing a hook belt a still simpler means of escape is available. The line should either be made fast as before or, if the fireman is working with a hook ladder, another method is to make a bowline on its end and slip this over the head of the ladder. A round turn should then be taken with the upper or standing part of the line round the bill



Fig. 20. Sketch showing method of descending a rope hand over hand.

of the hook on the hook belt and the line passed round behind the back and held at arm's length (Fig. 21). The slack can then be paid out as required, the speed of descent being controlled by the hand behind the back. A rigid hook type of belt is illustrated, but this method can also be used with a swivel hook type.

Great care should be exercised when making the round turn to ensure that the upper part of the turn is on the outside (Fig. 21, *inset*) when the turn is complete. If the turn is taken with the

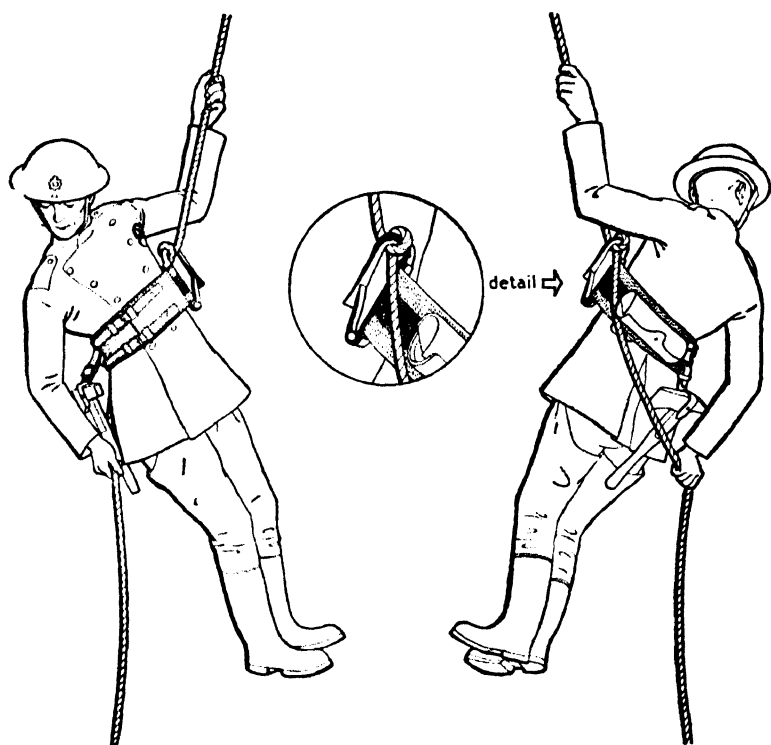


Fig. 21. Sketches showing method of escaping from a building by use of hook belt. Inset : detail showing correct method of leading line round the hook.

upper part on the inside, the line is liable to travel down the hook towards the spring and its pressure on this may cause the first part of the turn to become detached from the hook. There will then be only one part of the line rove and the man will be unable to control the speed of his descent.

Firemen may also be trapped or cut off by the spread of fire when they are at work with branches on a roof, parapet or the upper floor of a building. A line may not be available in such circumstances, and a possible method of escape is to make the hose fast to a chimney stack or other convenient object and slide down it.

SPECIAL AND UNUSUAL RESCUES

The Fire Service is often called to assist persons whose lives are in danger through causes other than fire. Some of the more common types of rescues which may have to be carried out are dealt with below, but it should be appreciated that the list is in no way comprehensive.

I. RESCUES FROM SEWERS

The Fire Service may occasionally be called to rescue persons who have been trapped or overcome in a sewer. This kind of occurrence is generally due to the presence of what is called "sewer gas," which is a mixture of methane (CH_4) and sulphuretted hydrogen (H_2S) (see Chapter on "Special and Unusual Risks"). Both gases are inflammable and will explode when mixed with the correct proportion of air. Sulphuretted hydrogen is extremely toxic and if breathed, even in low concentrations, will rapidly cause coma and then death. The principal points to remember in connection with such rescues are :—

(a) The essence of a sewer rescue is speed. Sewer men work without breathing apparatus, and if a man is overcome whilst below ground, the only hope of saving his life is to get him out quickly and get resuscitation apparatus to work immediately. Every effort should therefore be made to get to the spot as quickly as possible. *The rescue should never be attempted without breathing apparatus*, since it is almost certain that noxious fumes will be present, and in order to save time the crew should check their sets, and if possible put them on, while on their way to the job. An ambulance should always be requested immediately a call is received to a sewer rescue and resuscitation apparatus should be ordered on as a matter of course.

(b) The sewers usually lie at some distance below street level, and vertical shafts (Fig. 22), fitted with iron ladders leading down from manholes in the road or footway are provided at intervals to give access to the various sections of the sewer. It is by means of these manholes that a sewer rescue must be made.

(c) When sewer men are at work, one man, known as the surface man, is invariably left above ground to keep in touch with the men below. It is generally from this surface man that the call will have been received and the first action of the Fire Service officer should therefore be to contact him and find out exactly where the sewer men below were

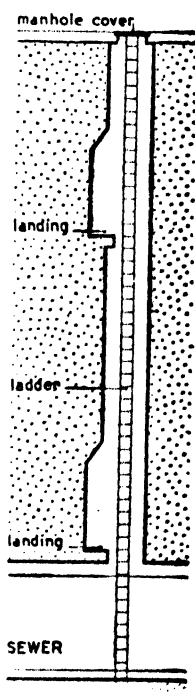


Fig. 22. Diagram showing the construction of one type of sewer shaft.

working, since this may avoid time being lost in searching in the *wrong direction in the sewer*.

(d) As soon as the manhole nearest to the probable position of the trapped person has been located, two men should go down the shaft and proceed along the sewer. The men should always work in pairs. It is good policy for each man to take a spare oxygen cylinder with him, as the supply of oxygen thus made available may not only prove the means of saving the rescued person's life, but may also be invaluable as a reserve supply, should it be necessary for the rescuers to remain for a long time underground. There have been occasions when it has been necessary for the rescuer, in order to save the patient's life, to give him oxygen from his own supply by disconnecting the supply tube to his own apparatus, and such a proceeding would have been unnecessary if a spare cylinder had been available.

(e) A third man should go down the shaft and remain at its foot, while a fourth man remains above ground, so that contact may be maintained between the rescuers and the surface at all times.

(f) Manhole covers on either side of the entry point should then be removed, for the double purpose of affording ventilation and enabling a certain amount of daylight to enter the sewer, and so allow the rescuers to ascertain whether or not there is another manhole nearer to the trapped person than that by which they entered. It sometimes happens that rescuers who have proceeded for a considerable distance down a sewer to reach a trapped person find that he is actually only a few yards from another shaft, and if he can be taken to the surface by that shaft much of the difficult business of dragging him along the sewer, which is often very narrow, will be avoided.

(g) A sewer trolley (see Part 2, p. 172) is valuable for getting the victim along the sewer, but if none is available he will have to be either carried or dragged along the sewer until a shaft is reached up which he can be hauled to street level. The best method of raising him to ground level is for a bowline to be passed under his armpits and the line hauled on by the men above while a fireman mounts the ladder immediately below the body assisting the work of the men above.

(h) The importance of adequate illumination at such work cannot be over-emphasised, but all lamps used in sewer work should be of the sparkproof type, as a precaution against the presence of explosive gases, and no naked lights of any type should be allowed. In many sewers a safety chain, located immediately downstream of the sewer manhole, is hung across the sewer when men are at work upstream, to act as a hand grip to prevent them being carried away by any sudden increase in volume and velocity of the water during storms, etc., and it will be found helpful if a light is hung on this chain. If there is no chain, the man at the base of the shaft should hold the light, so as to guide the rescuer back to his point of entry.

(i) It should be borne in mind that if a man collapses in a sewer the pressure of the water backing up behind his body may carry him for a considerable distance downstream of where he was working.

(j) Should an ambulance not have arrived by the time the victim is got to the surface, artificial respiration should be applied, preferably in conjunction with a resuscitation set. If such a set is not available, the possibility of using oxygen from a spare breathing apparatus cylinder should not be overlooked. The victim should, of course, at the earliest practicable moment, be removed to hospital for medical attention.

2. LIFT RESCUES

Many people each year are involved in lift accidents and the Fire Service is not infrequently called on for assistance. Such lift rescues can be divided into two principal classes :—

(a) Those in which the victim is in danger because he has been caught in or by the moving parts of a lift ; and

(b) Those in which the victim is in no danger, but has been shut in a lift car between floors.

Of these two classes, the first is naturally the more serious and therefore more difficult to deal with. When sending a message back about such an accident it is important to differentiate clearly between the two types of occurrence, particularly in a message to the Lift Company, since the fact that someone is in danger will indicate a higher degree of urgency, since human life is at stake. Accidents also sometimes occur as a result of electric shock due to some part of the lift car having become electrified through a defect in an electric circuit, but such accidents are seldom serious from the mechanical point of view, as they usually occur while the car is standing at a landing. If the accident occurs to an operator while the car is in motion (causing it to stop between two floors), then it should be dealt with as in section (b) below. For the method of rescuing persons in contact with electric wiring see the Chapter on "Electricity and the Fire Service."

(a) *Persons Caught in Lifts.* Accidents of this type with electric lifts are frequently caused by over-familiarity, combined with ignorance of the risks involved, on the part of workmen or cleaners, but may be also caused by passengers getting some part of their bodies caught, usually between the lift car and the structure of the building. The injuries caused by such accidents are often of a horrifying nature, but it should never be assumed that the victim is dead until he has been so certified by the doctor, for the safety devices usually incorporated in the more modern lifts often serve to avert fatalities by cutting out the mechanism, particularly in the case of electric lifts.

The procedure to be followed at a lift accident will depend largely upon the type of lift involved. The majority of lifts installed in modern buildings (particularly in departmental stores, blocks of offices, hotels and similar premises) are electrically operated, but some hydraulic lifts may still be found. In factories and other industrial premises both hydraulic and belt-driven lifts are still common, the latter type particularly in the North of England. The first action at any lift accident should, therefore, be to ascertain,

either by enquiry or by inspection of the lift mechanism, the type of lift involved.

The circumstances of each individual case will inevitably dictate subsequent action, and it is therefore impossible to give precise directions, but it will be found that there are certain general rules which can be laid down for the guidance of officers who find themselves confronted with a lift accident.

(i) *Electric Lifts.* The lay-out of a typical electric lift installation

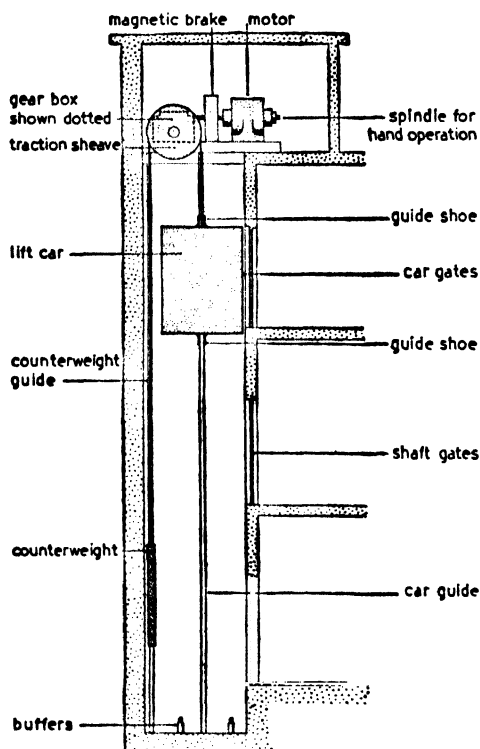


Fig. 23. Diagram showing typical electric lift installation.

is shown in Fig. 23, and the usual arrangement of a motor house can be seen in Plate 29, facing p. 140. The power is supplied by a heavy duty electric motor to a drive shaft, and from thence, through a worm gear, to a large traction sheave on which the suspension cables travel (on earlier models a drum was sometimes employed in place of the sheave). Magnetic brakes (see Fig. 24) are fitted on the drive shaft between the motor and the worm gearing. The lift car is slung by means of suspension cables led from the top of the car, over the traction sheave, to a counterbalance weight, which is usually equal to the weight of the car plus 50 per cent. of the maximum permissible

load. To prevent lateral movement of the car, shoes are fitted at the top and bottom, which travel in guides at the sides of the shaft. The counterweight is also fitted with guides to prevent it swinging out into the shaft. The lift is operated by means of switches inside the car, consisting either of push buttons or a handle operating on the "dead man's handle" principle.

Electric lifts are protected against accident by an elaborate system of safety devices, all of which are interconnected with the operating mechanism, so that the moment any one of them comes into action, the lift will automatically stop. Since one of the most

serious dangers with a lift is the possibility of anyone opening the shaft door when the car is not at that floor and either falling down the shaft or being crushed by the ascending or descending car, the primary safety device is an electrical interlock which prevents any shaft door being opened unless the car is at that floor. All shaft doors are fitted with these electrically operated locks, which are so designed that they can only be released by the presence of the car itself. The basic principle upon which such locks function is shown in Fig. 26 (*right*). (This drawing has been simplified for ease of reference, and it will be appreciated that it would be most unusual for the device to be fitted in so accessible a position.)

The shaft locks are interconnected with the main electric circuit of the lift mechanism and with the magnetic brakes in such a way that immediately a door is opened the current is automatically cut off, thus stopping the lift and simultaneously applying the magnetic brakes. The car door is not locked, but contacts are fitted to the catches by means of which the circuit is broken and the brakes applied if the door is opened while the car is in motion. As an additional precaution, the motor itself is fitted with a fuse or circuit breaker which cuts off the power and applies the brake if any considerable overload comes on the motor (*e.g.*, as the result of the car meeting an obstruction).

In addition to these automatic safeguards, an emergency stop button is usually provided to enable the lift to be stopped at any time from inside the car, and, on attendant-operated lifts, the handle is so arranged that if it is released it is automatically returned to the "off" position, thus stopping the lift immediately. Finally, to prevent the lift falling to the bottom of the shaft if the suspension cables should fail, automatic braking mechanism (known as the safety gear) is usually installed beneath the car. This mechanism is designed to arrest movement of the car in a downward direction, so that if the gear has operated, the only way of moving the car will be to haul it upwards.

The principal points to be observed when dealing with this type of accident are :—

A. Immediately on arrival, a responsible person should be contacted to find out on what floor the accident has occurred. Enquiries should also be made whether a doctor has been sent for and, if not, this should be done at once. The Lift Company should also be informed immediately, as many makers will send an engineer to all lift accidents. A plate will sometimes be found in the lift car on which is inscribed the maker's name, and also in most cases, an emergency telephone number. Instruction cards with similar information will also be found in the motor room. The presence of the Lift Company's engineer is not only essential for the subsequent repair of the lift, but will also prove of great value in the work of rescue itself, owing to his technical knowledge of the installation, and, though the Fire Service officer will normally take charge of rescue operations, he should always be consulted.

A man should immediately be detailed to go to the top of the shaft and another to the bottom to find out where the motor house is.

The information will be required later, and this is the quickest and most reliable method of securing it. When the motor house has been located, the main electricity switch should be opened to obviate any possibility of the lift being operated by power. The circuits are so arranged that the power to the lift motor can be cut off without switching off the lighting in the car.

B. The crew, on entering the building, should take with them the first aid kit from the appliance and a selection of suitable gear, such as a crowbar, screwdriver, large spanners and two long lines. Immediate first aid, such as applying a tourniquet to a crushed limb, is often essential in order to save the victim's life and, since this type of accident frequently necessitates cutting away, it will save time if the tools likely to be required are readily available. If a doctor is present he will usually wish to give the victim an injection of morphia.

C. On arrival at the lift car the first action should be to look at the suspension cables to see whether they are slack or taut. Cables leading both to the car and the counter-weight should be examined, since these are sometimes independently rove. If the cables are taut then the lift is safely held by the braking mechanism, but if there is any sign of slackness the cage should be secured against further uncontrolled movement, by making a line or lines fast to the guide shoes at the top of the cage and securing it higher up in the shaft. A line used in this way must always be protected against chafing by packing it with suitable material. Lift cars are often heavily built (though the average is about 12 to 15 cwt., larger types may weigh several tons) and since the breaking strain of the standard 2-in. manila line is 35 cwt., it will be advisable either to use more than one line or to double (or treble) the falls of the line in use. The danger of slack suspension cables is greater with the earlier drum drive mechanism than with the modern traction drive shown in Fig. 23. (A drum type machine can be immediately identified by examination of the motor installation.)

D. If no reliable witness is available who can describe the accident, the way the body is lying, the position of the lift and any switches, etc., should be studied, in order to ascertain in which direction the lift was travelling when the accident occurred. In general, the best course is to attempt to move it in the opposite direction from that in which it was travelling when the victim was caught.

E. If a steel-shod wooden lever or other heavy wedge-shaped tool is available, it may be possible, by levering the lift horizontally, to free the trapped person sufficiently to enable him to be extricated. A quite considerable movement can also sometimes be obtained by removing the guide shoes at the top and bottom of the car and swinging it over towards the back of the shaft. The presence of the safety gear cams on or close to the lower guide shoes may limit movement at this point, but some 3 to 4 ins. play should be obtainable at the top. It is usually a fairly simple matter to remove the shoes if the top or bottom of the car can be reached. Taking the shoes off in this way does not affect the safety of the lift, since it will still be suspended by the cables.

F. It should be remembered that if the victim is suspended in any way by the lift, then his body should be suitably supported before the lift is moved.

G. If the lift cannot be moved sufficiently by leverage, or by removing the shoes, then it must be operated, but it is essential, in order to cause the minimum of disturbance to the injured person, that this should be done by hand. Provision is always made on electric lifts for operating them by hand, normally by means of winch handles, but sometimes by a hand wheel. If winch handles are employed, they will usually be found hanging on the wall near the hand-operated spindle. If no winch handles are available, a ratchet spanner provides a good substitute, for it does not have to be removed from the shaft square after each turn. On some

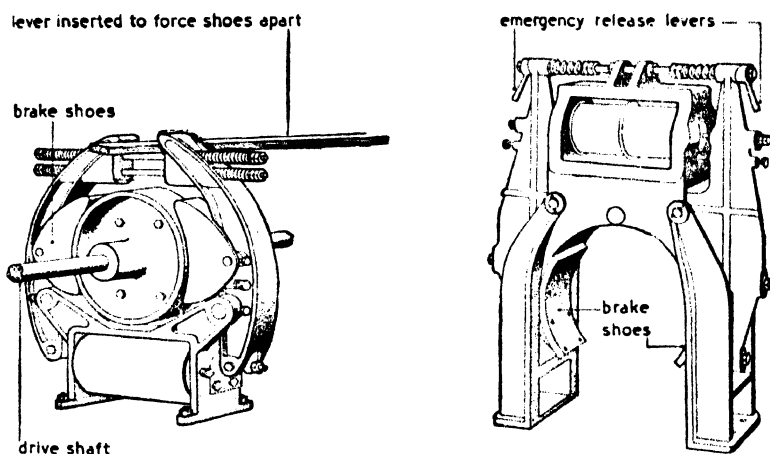


Fig. 24. Sketches showing two common types of magnetic brake. Left : brake without release levers, showing method of freeing. Right : brake fitted with emergency release levers.

earlier types of lift, tommy bars which had to be inserted in holes drilled in either the coupling between the motor and the gearing or on the brake wheel, were provided for hand operation, and these may occasionally still be encountered. In the remote possibility of there being no provision at all for operating the lift by hand, a Stillson wrench should be used on the motor shaft.

The position of the hand-operated spindle should be clearly indicated on the lift mechanism, but if it is not marked it can be located without difficulty, since it is invariably a squared extension of the motor armature shaft (see Fig. 23 and Plate 29). It is sometimes fitted with a removable cover, and it is always wise to have a screwdriver available in case it is necessary to unscrew the cover plate. If there is no such spindle (possibly because owing to lack of space the end of the shaft comes near a wall), then the coupling or brake wheel should be examined to see whether either is drilled for a tommy bar. The direction of rotation for moving the lift

upwards or downwards is usually indicated on the motor body, sometimes by a brass plate screwed on to the metal work, but more often by a painted arrow. It is, however, unwise to rely entirely upon this indication, since the plates have been known to indicate the wrong direction. Winding should be commenced at the slowest possible speed, and the movement of the cables should be watched.

To operate the lift by hand, all that is necessary is for the winch handle to be shipped and operated by two men while a third man frees the magnetic brake in order to release it. There is so much variation in the design of magnetic brakes that no general directions for releasing them can be given, but their operating principles are extremely simple, and the method will usually be obvious on examination. Some types of brake are fitted with emergency release gear (Fig. 24, *right*), while others are so designed that it is a simple matter to release them by exerting pressure on link rods or other fittings (see Plate 29, facing p. 140). There are a few types, however, which cannot be released except by forcing the brake shoes apart with a crowbar or other lever. One method of doing this is shown in Fig. 24 (*left*). If the magnetic brakes have been freed by means of the emergency release gear, it is essential that this should be reset immediately after hand operation has ceased. On some types the brakes are automatically re-set, and examination of the brake will reveal whether or not this automatic gear has operated.

The reduction gear is almost invariably reversible, so that the brake must only be released after the handle or tommy bar is securely held, and must be applied before the handle is let go again. While the lift is being operated, one man should be stationed at the scene of the accident to observe the movement of the car, and he should be the only one permitted to give orders. The method of hand operation for the latest types of high-speed lifts is on different lines, generally consisting of a secondary system of gearing, but where a lift of this type is installed there will always be an experienced maintenance engineer on the premises, who will be able to describe the method of operation.

H. If the trapped person cannot be extricated by any of the methods described above, then cutting away may have to be resorted to. On some types of lift, such as those which travel up the centre of a staircase and have a partially open steel shaft, this may be a fairly simple matter, particularly if an oxy-acetylene cutting set is available. On the other hand, cutting into the modern type of brick-built totally enclosed fire-resisting shaft may present considerable difficulties, and every possible precaution should be taken against movement of the car while the work is in progress. If an oxy-acetylene set is being used care must be taken to shield the victim from sparks and hot metal.

I. Accidents are occasionally caused by a workman getting caught by the counterweight. This is invariably fitted with guide shoes similar to those used on the car, and the quickest way to release the trapped person is usually to remove these and swing the weight clear. The main electricity switch in the motor room

should be pulled before anyone is allowed to enter the shaft for rescue work, and it is advisable to leave a man on duty by the switch to make sure that it is not re-closed. If the rescuers have to enter the shaft or pit, the counterweight should be watched to ensure that no one is injured by it. If swinging the weight clear does not enable the trapped person to be freed, it will be necessary to operate the lift mechanism by hand. It should be remembered that the manual gear will have to be operated in the reverse direction from that indicated on the motor for raising and lowering (*i.e.*, to *raise* the counterweight the gear must be operated in the same direction as that for *lowering* the car).

J. It is worth remembering, if a person is seen to be in danger of being trapped by the moving car of a lift, that most lifts can be stopped from inside the car even if no emergency stop is fitted, simply by opening the inner door; and opening the shaft door from a landing will have the same effect. This action opens the interlock safety circuit and causes the magnetic brakes to come into operation.

(ii) *Hydraulic Lifts.* The fact that a lift is not electrically operated can usually be recognised by inspection of the car, since both hydraulic and belt-driven lifts are operated by means of a steel-cored rope, known as the control or operating rope, which passes through the floor and ceiling of the car in one corner near the entrance gate. The car of a hydraulic lift is raised and lowered by means of a ram working in a cylinder, which may operate either directly on the bottom of the car or platform or through a system of cables which raise or lower the car, and the presence of such a ram will immediately identify the type of lift. It is, however, not always easy to distinguish a hydraulic from a belt-driven lift if the ram is not visible, as there is superficially nothing to distinguish one from the other. The car is similar, as is the counterbalanced suspension and the method of operation. Enquiry of the occupiers will, however, usually reveal the type of lift involved, and if this does not do so, inspection of the mechanism will at once make it apparent.

The majority of small hydraulic passenger lifts are being superseded by electrically operated lifts, and the few that remain are very old and the safety arrangements are in consequence not infrequently inefficient. For this reason, and also owing to the absence in many cases of automatic stopping mechanism, the injuries inflicted by hydraulic lifts are frequently extremely serious and immediate first aid is imperative. The larger modern hydraulic lifts are, however, equipped with electrical safety locks to the car and shaft gates, so arranged that the control rope is gripped and the car stopped if any gate is opened. Closing all the gates completes the circuit, energises the gripper and releases its hold on the rope.

There are two principal valves on a hydraulic lift system, the control valve and the stop valve, and it is important that the difference between the two should be understood. The control rope is connected to a long lever which operates the control valve on the lift mechanism, pulling the rope downwards causing the lift to

ascend, and *vice versa*. The neutral position of this lever is usually horizontal but may, exceptionally, be vertical. Guides are, however, usually fitted to limit its travel, and the neutral position is in the centre of the arc of travel. Returning the valve to the neutral position does not, however, affect the hydraulic power, which remains available so long as the stop valve is open. This valve is usually fitted on the hydraulic power line immediately after it enters the building, and may be some distance from the installation. It can be located by tracing back along the high pressure main until the valve is found. This is the valve employed to put a hydraulic lift out of commission. The Hydraulic Power Company also fit for their own use a secondary main valve, which is invariably situated outside the building and is indicated by a tablet similar to a hydrant plate, with markings specified by the Hydraulic Company concerned. Unless, owing to failure of the mechanism, an attempt is to be made to move the lift by hand, neither the stop valve nor the Hydraulic Power Company's valve in the road should ever be turned off, since, if either is closed, no power will be available to operate the lift. Cutting off the hydraulic power at the stop valve, whilst it does prevent the lift car from being raised, does not prevent it being lowered, since this action is governed by discharging the water in the ram cylinder to waste, and no retaining valve is fitted on this discharge line. It should therefore be clearly understood that, even though the stop valve has been closed, it is still possible to allow the car to descend by pulling the control rope.

The first action when dealing with an accident in a hydraulic lift should be to detail a man to proceed to the control valve lever, return it to the neutral position (thus relieving the car from pressure in either direction), and remain there to see that it is not tampered with, in order to prevent any further movement of the car. It is also advisable, as an additional precaution, to lash the control rope so that it cannot be operated. It may sometimes be found that the control lever is in an inaccessible position, and in such circumstances lashing the control rope is the only way to prevent the lift being operated. Some lifts of this type are also fitted with a screw grip for locking the control rope inside the car and this should be used if available.

The procedure at a hydraulic lift accident is otherwise similar to that outlined above for electric lifts, with the exception that there is no provision for operating the lift by hand, but if the control rope is operated carefully, it is possible to secure extremely sensitive control and the lift can be moved very slowly and only an inch or two at a time. In the case of a lift fitted with an electrical safety device, it may be necessary to release the rope gripper before the control rope can be operated. The rope gripper is usually situated on top of the car and can be wedged open. The best procedure is for the rope to be operated by one man while another watches the movement of the car and gives any necessary instructions. In the unlikely event of complete failure of the hydraulic mechanism, the lift should be secured by lines to prevent uncontrolled movement.

It will then, of course, only be possible to move the lift by means of block and tackle, which should be bent on to the top of the car.

(iii) **Belt-driven Lifts.** Belt-driven lifts are principally found in factories and other premises where the presence of power shafting makes the employment of this form of drive both convenient and economical. The manner in which the power provided by the factory shafting is applied is shown diagrammatically in Fig. 25. A large pulley wheel (*a*) is keyed to the shafting and two belts (*b*) and (*c*) are led from it to pulleys (*d*) and (*e*) on a drive shaft (*f*). The direction of the drive is reversed, in order to provide for upwards and downwards movement of the lift, by crossing over one of the two belts. The pulleys (*d*) and (*e*) rotate on, but are not keyed to, the shaft (*f*), and when the lift is not in operation will be driven round by the pulley wheel (*a*) without affecting the lift mechanism. A third pulley (*g*) between the two pulleys (*d*) and (*e*) is, however, keyed to the drive shaft. The lift is operated by means of forks (*h*)

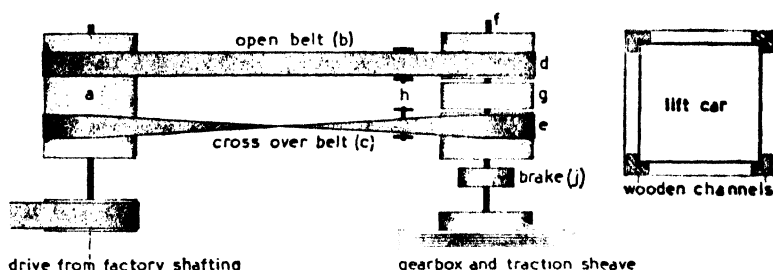


Fig. 25. Diagram showing the principles of operation of a belt-driven lift.

operated by the control rope, which pull the appropriate belt on to the fixed pulley, thus rotating the shaft (*f*) and transmitting the drive through a worm or spur gearing to the traction sheave. A brake (*j*) is usually fitted on the drive shaft, being interconnected with the forks (*h*) and brought into operation when the lift gear is in neutral.

The dangers of accident with the belt-driven type of lift are similar to those on a hydraulic lift. Shaft doors are fitted, and these are in many cases provided with safety locking mechanism, but it may be found on very old installations that there are no car doors, and since the shaft doors are installed on the outer surface of the brickwork of the shaft, which is often as much as 18 ins. to 2 ft. in width, there is a substantial sill which can give rise to accidents. Rescue procedure is similar to that for other types, but it should be noted that on many belt-driven lifts it is impossible to obtain sideways movement by removing the guide shoes, owing to the fact that the car is a close fit in the shaft and runs, not on shoes but in wooden channels (Fig. 25 *right*) at each corner of the shaft.

No method of hand operation is normally provided on a belt-driven lift, but if it is necessary to operate such a lift by hand, the best

procedure would be to get the shafting stopped, remove the belting, and operate the gear, either by means of a Stillson wrench on the drive shaft or by hauling on the gearing, releasing the brake as required. The car should be slung before the belts are removed.

(b) *Persons Shut in Lifts.* Accidents of this type are comparatively straightforward. It will usually be found that the stoppage is due to failure of the lift mechanism, and the obvious course is to proceed immediately to the motor house, open the main electric switch and operate the lift by hand to the nearest floor. Operating a lift by hand is frequently an arduous job, and considerable labour will be saved if the car is taken in the easiest direction. If there are only one or two persons in the car it will usually be easier to wind it upwards, since the counterweight (which in general practice is the weight of the car plus 40 to 50 per cent. of the maximum load) will then be assisting. If the car is full, on the other hand, it will usually be easier to wind it downwards. It should be remembered that, if the magnetic brakes are released, it will be necessary either to maintain a continuous pressure on the winch handles or to re-engage the brake at intervals. This is especially the case when operating a lift by tommy bar, since the bar usually has to be taken out every quarter turn and inserted in a fresh hole, and the magnetic brakes must be engaged while this is being done.

When the car reaches floor level, the automatic lock allows the shaft doors to be opened and the imprisoned persons to be released. Any subsequent action should be left to the representatives of the Lift Company concerned. Care should, however, be taken to see that the lift is left in a safe condition, so that it cannot be operated until the Lift Company has remedied the defect. The best way to do this is to leave the main power switch open, so that the lift cannot be power operated. Care should also be taken to see that any shaft gates which have been forced or otherwise damaged are carefully secured before the Fire Service leave the premises.

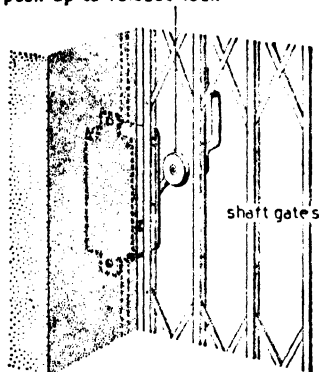
In extreme cases it may be found that the lift has become jammed and cannot be operated by hand. In such circumstances the best course is usually to effect an entry through the shaft door, at the floor immediately above the point at which the lift has stopped, and then to lower a ladder down on to the top of the lift. On many lifts there is a trapdoor in the roof of the car to permit persons to escape in such an eventuality and the trapped persons can then be extricated without difficulty. If there is no such door, a hole should be cut in the roof by one or other of the methods described in Chapter 35. Entry should only be attempted through the floor of a lift as a last resort, as this is invariably of very solid construction, usually consisting of a wood floor lying in a steel frame.

It should be emphasised that the shaft doors, which are often of elaborate construction and expensive to replace, should only be forced as a last resort. There is seldom any necessity for speed when persons are simply shut in, as distinct from trapped by, a lift, and a careful examination of the shaft will usually reveal the whereabouts, usually either at a top corner or in the centre of the door, of the cam-operated device by means of which the doors are

unlocked; this can then be operated by hand to release the lock (Fig. 26). Such shaft doors can, of course, only be opened in this way if they are of the open collapsible type, since it will otherwise be impossible to get a hand through the door to operate the safety device. The most modern type of solid door will usually have to be forced, except in the rare instance where an emergency key is provided for opening certain of the shaft doors.

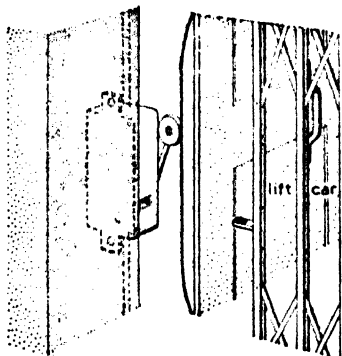
Persons may occasionally be shut in a lift owing to failure of the suspension cables. Accidents of this type are rare, but have been known to occur, especially with the earlier drum drive mechanism, where the car was suspended by a single cable. Since the safety gear (see p. 175) is designed to protect the car against further downward movement, the lift can only be raised upwards, even if

push up to release lock



GATE CLOSED

switch operated by cam on lift car



GATE OPEN

Fig. 26. Typical automatic locking device for shaft doors of an electric lift. On this type the roller should be pushed upwards to release the doors.

blocks and tackle are employed. The best course of action is usually to sling the car as a precaution against further movement, and then extricate the imprisoned persons through the roof of the car. If the car is near a higher floor level, however, it may sometimes be simpler, especially if no door is fitted in the roof of the car, to raise it by means of block and tackle. Under no circumstances must any attempt be made to release the safety gear, since the car would then fall to the bottom of the shaft.

Finally, it should be remembered that when a lift rescue, of whatever type, has been effected, *no attempt should be made to get the lift working again*. This is a job for the Lift Company concerned and the matter should be handed over to them the moment the rescue has been effected.

3. RESCUES FROM CLIFFS, WELLS, ETC.

(a) *Cliffs*. The Fire Service is occasionally called to the rescue of persons who have fallen down a cliff or quarry, or for any other

reason have become trapped in inaccessible positions. The following points may be noted :—

(i) The obvious method of rescue is for a man to be lowered down to the trapped person. The principal risk during this operation is from falling débris (particularly if the accident has been caused by a fall of the cliff face) and the rescuer should therefore wear a steel or other helmet. Cliffs and quarries in a limestone formation are particularly liable to be dangerous in this way, and if the face has been weakened by a fall, the slightest vibration is likely to dislodge further débris.

(ii) When the trapped person has been reached and the line made fast to him, it is usually safer to lower him down further to the ground (if this is possible) rather than attempt to haul him to the top.

(iii) There is seldom any convenient object at the head of a cliff to which a line can be made fast, and the axle of an appliance can frequently be used for this purpose. The practice of using the appliance to draw the person up is, however, dangerous, and should not be permitted, since if the line should become caught, the power of the vehicle may cause it to break.

(b) *Wells, etc.* Workmen are sometimes trapped at the bottom of a well, owing either to failure of the hoisting mechanism or to their being overcome by noxious fumes. The principal danger in such rescues is the possible presence of fumes, and the rescuer should always wear breathing apparatus. A helmet should also be worn as a precaution against falling material. It may take a considerable time to haul a heavy body from a deep well, and it is advisable as a safety measure for the rescuer to take down a second line, which is paid out as he descends and can be used to haul up the trapped person. The rescuer can then remain attached to his own line, which (when he is at the bottom and the weight is off it) can be used for signalling or in an emergency for hauling him out. It is advisable also for the rescuer to take down a strong light, which can be used as an indication to the men above that he is all right.

If the winch gear at the top of the well is derelict, or has been damaged, a sheer legs or derrick should be rigged across the top of the well, since if the rope is led over the side, it may cause the brickwork to become dislodged and injure the man below.

Rescues of this type are also sometimes made necessary by persons falling down a disused pit shaft or dene or other hole in the ground. Occasional calls are even received to workmen who have fallen down inside a hop kiln, and it is worth remembering that there are doors at the base of the kiln through which such persons can be extricated. Workmen trapped in a chimney present a more difficult problem, and it is usually necessary to cut away brickwork (Plate 30) to extricate them.

4. MISCELLANEOUS AND SPECIAL RESCUES

(a) *Persons Trapped in Machinery.* When called to a person trapped in machinery, the most important point to remember, if a doctor is not already in attendance, is the necessity for calling

one and for the administration of immediate first aid. Accidents of this type are usually caused by the hand or a limb being trapped in the moving parts of the machine, resulting in multiple and freely bleeding injuries. The immediate application of a tourniquet to the injured limb may be the means of saving the patient's life, and, where possible, the lacerated part should be covered so that the victim, who may sometimes be relatively free from pain, cannot see the extent of his injuries. An ambulance should be ordered immediately on the receipt of a call to such an accident.

The injured person can sometimes be extricated by reversing the machine, or raising it by means of slings, but in extreme cases amputation of the limb may be necessary, and for this it will be necessary to await the attendance of a surgeon or doctor. In any case, if the victim is suspended, the weight of the body should be taken by slings. It is worth enquiring whether the machine is made of cast-iron or steel, since, if it is cast-iron, a well-directed blow may fracture it sufficiently to allow the injured person to be released. It is difficult to generalise about accidents of this type; but in all such cases it is advisable to consult the firm's engineer.

(b) *Persons Rescued from Rivers, etc.* The Fire Service is, from time to time, called on to rescue persons in danger of drowning, and is sometimes summoned to assist in reviving the apparently drowned with the aid of artificial respiration and resuscitation apparatus. The best type of apparatus for this sort of work is the rocking stretcher described in Part I, p. 226, combined with the use of resuscitation apparatus. The essential thing to remember is to clear the patient's stomach of water (by holding him upside down) before commencing artificial respiration, which should be carried out simultaneously with the use of the resuscitation apparatus (see Chapter 12).

Methods of rescuing persons in difficulties in the water will be found in the section on life saving in Volume 1 of the *Manual of Seamanship*.

(c) *Children Trapped in Railings.* This is a fairly frequent occurrence in cities. A child puts its head through railings to get a ball, or for some other reason, and then finds he cannot withdraw it. In extreme cases, the railings may have to be cut with a hacksaw or an oxy-acetylene cutting set, but a simpler and quicker method, which can be employed on less substantial railings, is to use an ordinary vehicle jack to force the railings apart. In one large city so many calls of this type have been dealt with that a special tool, consisting of a large bottle-screw or turnbuckle with shoulders at each end, has been constructed for this purpose.

(d) *Persons under Vehicles.* The Fire Service is frequently called to accidents of this kind, and in some parts of the country special lifting gear is carried for the purpose. In one city, for instance, a number of specially designed quick-acting jacks have been provided by the Transport Undertaking and are kept on appliances at selected stations. Such work is mostly a matter of common sense, but it is important to remember that the majority of such accidents are caused by persons stepping off the pavement, and occur on the

camber of the road. Care should therefore be taken (particularly if, in the absence of special equipment, ordinary car type jacks are being used) to prevent the vehicle slipping off the jacks, and blocks of wood, bricks or any other available material should be used to chock up the vehicle as it is raised, so as to take its weight if any of the jacks should slip.

(e) *Collapse of Buildings.* Accidents of this nature are fortunately rare, but are always possible, particularly during building operations or when demolition work is being carried out. The principal thing to remember is that all utility services, gas, water and electricity, should be disconnected at the main, and that any domestic fires which are still burning should be extinguished. Precautions should also be taken to protect the rescuers against further collapse. It is impossible in this *Manual* to deal with the recovery of victims trapped by the collapse of a building, whether caused by enemy action or otherwise, and the reader is therefore referred to the *Rescue Service Manual* * for further information on this subject.

5. THE RESCUE OF ANIMALS

Provided that the lives of firemen are not unduly risked, attempts should always be made to rescue any animals which are in difficulty or danger, not only for humanitarian reasons, but also because it is distressing to the public to see animals in pain. The rescue of horses and cattle often presents considerable difficulty, but the following notes may be of assistance :—

(a) Before animals can be removed from their stalls it will be necessary to release their halters. Horses are usually secured by a rope attached to the bridle, which is then passed through a ring or shackle in the wall and knotted beneath a block of wood or other weight (Fig. 27). No attempt should be made to untie the knot beneath the weight, since it is always left intact by the stableman, and consequently with the continued pressure of the weight becomes tightly locked. Instead, the knot at the bridle should be released. In some stables it is the practice to insert between the wall shackle and the halter a quick-release shackle (Fig. 27 *below right*), which can be opened by finger pressure. Cattle are usually secured by a chain passed round the neck and then fastened with a hook or peg.

(b) Horses and cattle may sometimes be freed from their stalls by means of a remote control fitting which automatically releases all halters. In a large modern stable it may be advisable to enquire whether there is any such fitting before attempting to release the halters individually.

(c) The best method of taking horses out of a burning stable is to blindfold them so that they cannot see the flames (by covering their heads with empty nosebags, split sacks or large pieces of cloth) and then to back them out. If it is necessary to use force, then the best method is to get in front of them, seize them firmly by the nostrils and force them out backwards.

* Air Raid Precautions Training Manual No. 3—Rescue Service Manual
Published by H.M. Stationery Office. Price 1s. 6d. net.

(d) It will be found of great assistance if the owner or stableman can be located, since animals will respond more readily to persons whom they know.

(e) Cattle are more difficult to take out forcibly, but if the door of the stable is opened they will often make their own way out more readily than horses. The field gate should also be opened, so that they can reach their usual pasture rather than remain to become a menace on the fireground. They should be watched, and if necessary driven through the gate, since it has been found that cattle tend to stray back into a fire. If it is necessary to lead cattle out they should be taken by the ears, since this is their most sensitive part.

(f) A veterinary surgeon will often be able to give valuable assistance when animals have to be rescued from fires or other accidents. No hesitation need be felt in calling for his services, since arrangements have been made by the Royal Society for the Prevention of Cruelty to Animals to ensure that the cost of such attendances is met. It is also a wise plan for officers in rural areas and other places where animals are known to be kept to contact the local branch of the Society to ascertain whether any special facilities are available in that area.

(g) Horses, either from fright or other causes, occasionally get themselves into difficult situations, such as in an area or down an excavation. A breakdown lorry with crane is often necessary in such circumstances, but sometimes simple methods, such as throwing down bales of straw or hay and causing the horse to lift his feet and thus climb up on them, will solve the difficulty. In some parts of the country special slings for lifting horses (see Part 2, p. 182) are carried by the Fire Service, and in other parts of the country the Police keep such slings. The method of using them can be seen in Plates 31 and 32. If slings are not available, it may be

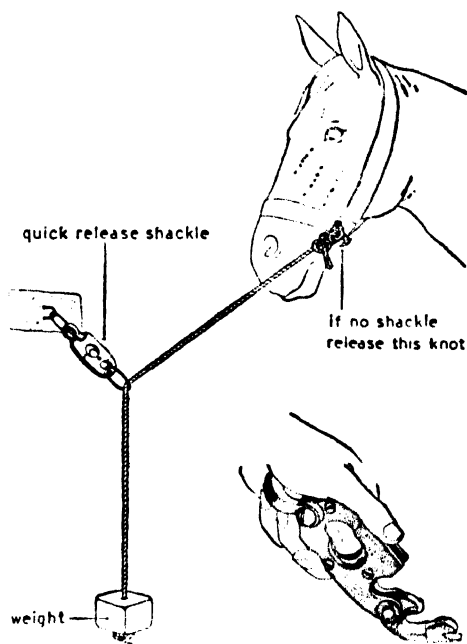


Fig. 27. Sketch showing one method of tethering a horse with (below right) detail of quick-release shackle.

possible to construct an emergency sling from an old length of canvas (unlined) hose by knotting the hose round the belly of the horse, in the same way that a body sling is put on a barrel (see p. 239), and attaching the line to the centre of the sling ; but this method should only be used in an emergency. Lines should not be used to form a sling, as this might cause injury to the animal.

The extent to which Fire Service equipment should be used for the rescue of small domestic animals, *e.g.*, cats up trees, must depend upon the circumstances of the case and the discretion of the officer in charge ; but, in general, if the men can be spared and firefighting efficiency will not be impaired, every effort should be made to assist the public by going to the rescue of animals in trouble. People often set great store by such pets, and many a small boy has been saved from distress by a fireman bringing out (usually without any great difficulty) a favourite cat or dog. If the animal is apparently dead the possibility of resuscitation should not be overlooked, as this has often proved successful. There is a case on record of an Alsatian dog which was apparently dead being revived by the use of resuscitation apparatus. It will, however, be found that in most cases where animals have been affected by heat and smoke, they will recover without assistance when taken into the open air and splashed with water. The possibility of first aid (if animals have been cut or burned) should not be forgotten. It is particularly necessary that cage birds should be removed to the open air at the earliest practicable moment, as they are very susceptible to the effects of smoke.

If it is found necessary to remove animals found in cages at hospitals, etc., they should, if possible, be removed in the cages. If this is impossible they should be taken together to a place where they can be confined, and not allowed to escape. It is also advisable to count them, so that the number can subsequently be checked to ensure that none are missing.

VENTILATION AT FIRES

EVERY experienced fireman keeps clearly in mind the necessity for providing for the correct ventilation of a building which is on fire. He does this for several reasons: to keep the heat in the building from becoming bottled up, thus leading to the further spread of fire; to obviate damage by smoke to commodities, furnishings, etc.; and to enable firemen to extinguish the fire without having to endure unnecessary smoke and heat punishment.

The art of correct ventilation is the art of inducing heat and smoke to leave the building as quickly as possible by such paths that a minimum of damage will be caused. Carried out correctly, ventilation will have a considerable effect in reducing fire and smoke damage; carried out incorrectly it may easily result in a fire spreading and getting out of control. A sound knowledge of how buildings are constructed is essential in order to know at what point in the many different types of building ventilation can be most easily and most effectively carried out. The proper course to follow varies with circumstances and it is only by experience that an officer can decide on the appropriate line of action. Every advantage must be taken of any special constructional features which assist ventilation, such as the stage lantern lights in theatres, light glazing over lift shafts, staircases etc., and this chapter should therefore be read in conjunction with the Chapters on "Building Construction" and "Special and Unusual Risks," which deal with such features and with certain cases, such as cotton mills, where ventilation until the fire is extinguished may prove unwise. Normal ventilation, as distinct from its application to fighting fires by the Fire Service, may be mechanical or natural, and has already been dealt with in the Chapter on "Building Construction."

I. BEHAVIOUR OF SMOKE

What is called smoke (see Chapter 1) at a fire is generally a mixture of smoke (usually fine solid carbon particles), fog (liquid droplets of combustible distillates together with droplets of products of combustion, usually water) and substances which may be released from materials involved in the fire.

At fires, air is often heated to over 1,000° F. and, because any given quantity of a hot gas is lighter than an equal quantity of the same gas at a lower temperature, it will tend to rise very rapidly and with great force, carrying the smoke with it. This is often shown by the way in which burning embers are carried to considerable heights, and is one of the reasons why, on large fires, solid jets of water of large diameter are required to do effective work. If a spray or broken jet is used the velocity of the rising gases is often sufficient to keep the water from reaching the seat of the fire.

Since hot air, gases and smoke thus tend to rise in a building on fire, the practice of ventilation is based on this principle.

2. OBJECTS OF VENTILATION AT FIRES

(a) Heated gases rise up any available pathway, such as staircases and lift-shafts, and if there is no vent or release at the top of the building they will spread out across the ceilings at each floor level of the building which confines them, carrying any flame which may be present. This is known as mushrooming (Fig. 1). It is one of the most frequent causes of the spread of fire through roof spaces or from floor to floor. The first object of ventilation is to prevent this mushrooming and so check the spread of fire.

(b) Due to the nature of smoke, with its possibly corrosive and oily constituents, damage will be done to parts of the building and

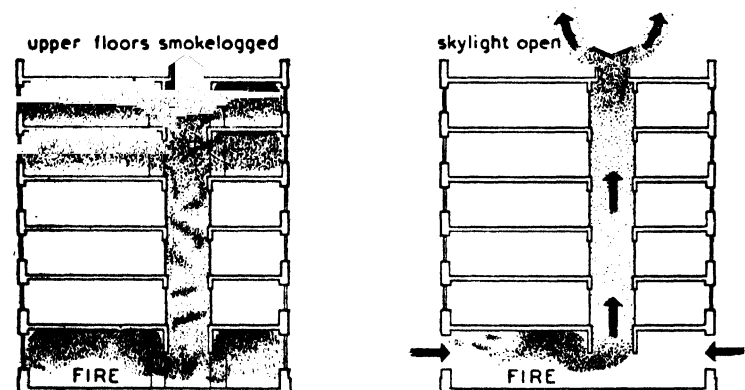


Fig. 1. Diagrams showing (left) mushrooming caused by failure to ventilate, and (right) the same building correctly ventilated.

to its contents which the fire does not reach. The second reason, therefore, is that by early ventilation much can be accomplished in the reduction of damage due to smoke.

(c) Again, owing to the nature of smoke with its irritant properties, and the reduced oxygen content of the air carrying it, working conditions for the fireman are always severe in heavy concentrations. The third reason for ventilation is, therefore, to enable the fireman to carry out his work more easily. This permits the rapid location of the seat of the fire and reduces the possibility of excessive water damage through using a jet prematurely.

3. WHEN TO VENTILATE

Matters which require the attention of the first officer to arrive at a fire may briefly be summarised as follows :—

- (a) Seeing that all occupants are out of any buildings endangered.
- (b) Determining the extent of the fire.
- (c) Sending any necessary assistance messages.
- (d) Getting the fire surrounded so that it will not spread.
- (e) Ventilating, which should not be embarked upon if it is likely to cause the fire to spread, and obviously should not be attempted if it would endanger the safety of any persons present. This is an essential precaution, because ventilation, if unwisely or incorrectly

carried out, may assist the rapid spread of fire. Subject to these considerations any steps which will aid the dispersal of smoke and facilitate moving about the premises should be put in hand at the earliest practicable moment.

Except in certain cases, such as where lantern lights are fitted, as in theatres and cinema projection rooms, ventilation should never be attempted until it is known that branches are in position and ready to prevent any spread of fire due to the admission of air.

Finally, there may be cases where releasing the fire would imperil other buildings, so that before cutting away roofs, and any obstructions which may underlie them, to assist ventilation, the necessary branches should be arranged to cover the extent of the fire and any "exposed" buildings, viz., those which may be endangered by the burning building.

After these precautions have been taken, ventilation should be put in hand as early as practicable. Occasionally, where a roof is inaccessible, it may be necessary to allow the fire to burn its way through the roof in order that pent up heat and gases may find a vent and so allow firemen to gain access from underneath and extinguish the fire.

Back Draught. There are certain precautions which can be taken against back draught (see Part 1, p. 30), but probably the best safeguard is first to provide plenty of ventilation above the fire and then to open doors and windows on intermediate floors to allow the ingress of air and to provide adequate passageway for the gases in the event of an explosion. The greater the vent area the less will be the force of the explosion.

4. HOW TO VENTILATE

(a) The ventilation of fires as carried out by the Fire Service should, as far as practicable, commence with the highest point in

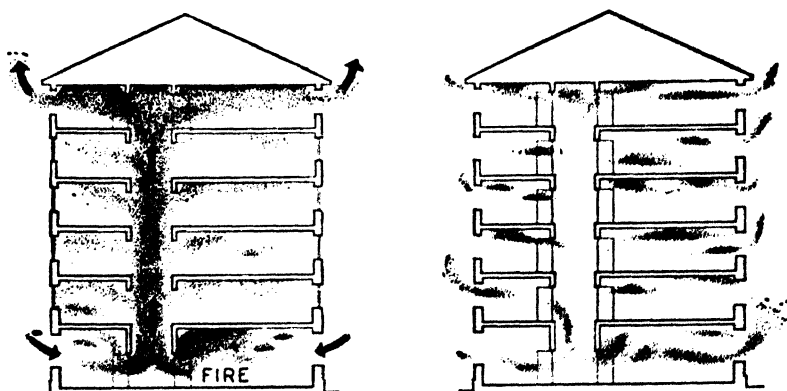


Fig. 2. Diagrams showing method of ventilating. Left : Initial stages, showing roof and ground floor opened up to provide a good flue. Right : intervening floors ventilated by opening doors and windows when a flue has been established.

the building which it is possible to reach, *e.g.*, the heads of staircases or lift shafts, and work downwards progressively. If it is impossible to reach a high point in the building by internal means it may be practicable to do so from outside. Once the heat and smoke are released near the top, the atmosphere will begin to clear rapidly, since air will be entering at the level of the fire through the same openings that are being used to fight the fire and a strong "chimney" effect will be obtained.

(b) Where the nature and density of the smoke or the possible presence of dangerous fumes justifies it, men wearing breathing apparatus should be employed to ventilate smoke-logged staircases and rooms. This permits them to work without severe smoke

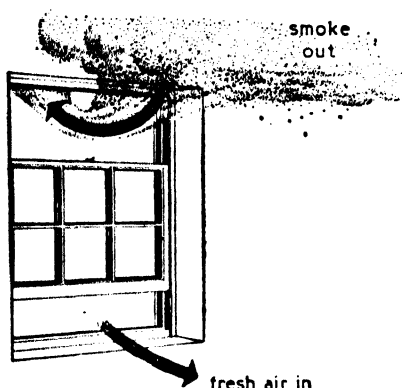


Fig. 3. Diagram showing method of clearing a smoke-logged room, by opening the window one-third at bottom to admit fresh air and two-thirds at top to permit smoke to escape.

punishment and to open up windows, etc., which might otherwise prove inaccessible. Men should be sent as early as practicable to open or, if this is not possible, to break the glass of windows at the heads of stairs and lift shafts, always provided that the layout of the building is such that an exposure hazard will not be created.

(c) For the individual room the natural form of ventilation is the open window or chimney. Windows of the sash type should be opened both at the top and at the bottom, two-thirds of the way down from the top and one-third up from the bottom. The top opening

allows the hot gases to escape and the bottom opening admits fresh air (Fig. 3).

A few buildings have windows which can be opened by rod gearing from street level. Such windows should not be operated until branches are in position (they should never be operated by the management), otherwise a draught might be created which would spread a small fire over the whole floor.

(d) Where a fire is extending through a vertical shaft, such as a lift shaft or staircase, the first step should be to try to release the fire at the top, either by breaking glazing, opening hatches or cutting through the roof. Skylights can sometimes be removed or even lifted off with relatively little damage.

(e) It is very important that when men are fighting their way up a staircase jets from the outside should not be got to work through any open windows in the building. This would not only stop the heat and smoke from finding a way out but drive it farther into the building, thus causing heavy punishment to the men inside.

If it is essential to ventilate from outside, men may be sent up to the roof, either through adjacent buildings or by means of ladders, or may be able to open or break outside windows from an escape or turntable ladder pitched against the building. If this is impossible, skylights can sometimes be smashed by a jet from a turntable ladder monitor. Cutting a hole in the roof to form a vent should only be resorted to when other equally good or better methods are not possible.

When making an opening in a roof the direction of the wind should be noted and a position taken up on the windward side, so that any sudden rush of smoke out of the hole is carried away from the fireman. It should also be remembered that, if there are explosive gases bottled up, there may be a sudden rush of air into the opening which will give warning of the outward explosive rush due to the rapid ensuing combustion which will take place. To make a roof opening, the slates should first be removed and, if the roof is close boarded, an opening of approximately 2 ft. $\times$ 2 ft. should be made in the first instance. It should be the aim to make as neat a job as circumstances permit. It may often be necessary after cutting through a roof also to cut through a lath and plaster ceiling, for example, if a cock loft or roof void is being opened up.

If there is obviously plenty of smoke bottled up, the officer in charge should not be satisfied with a 2 ft. square opening as a means of venting but should consider whether a larger opening in the roof is required and enlarge any opening made as his experience and judgment may dictate.

The importance of correct ventilation technique at a fire cannot be over-estimated, and in suitable cases one or more crews should be specifically detailed for this work. In many brigades in America ventilation is the specific task of "hook and ladder" crews, provided that no rescue work has to be done.

5. AFTER OPENING UP

Where an aperture has been made in a roof solely for the purpose of ventilation it would be manifestly unwise to play water into that ventilation hole, as the object of the hole is to induce a draught that will carry away the smoke and hot gases. If a jet is directed into the hole it will tend to drive the gases inwards. It is therefore necessary, when ventilating, to make sure that the operators of turntable ladders and of branches working from the roofs of surrounding property should know for what purpose the openings are being made.

6. SMOKE EXHAUSTERS

Before the outbreak of the second World War a number of brigades in this country were experimenting with smoke exhausters. (Part 2, p. 170). They had also been adopted on a small scale in France, Germany and America. In Paris in 1939 a smoke exhauster formed part of every first attendance at night and was automatically sent on to all basement fires. Such apparatus might well be useful in dealing with smoke-logged basements, sub-basements or holds of

ships. Experiments have also been made with air compressors, which force fresh air into the building to displace the smoke which is already present. At the moment there would not appear to be sufficient evidence accurately to appraise the value of either type of apparatus. Smoke exhausters find their greatest use at fires which, whilst not intense, give off large quantities of smoke and where the natural ventilation of the building is bad. Considerable discretion is, of course, necessary in their use to ensure that the very considerable air currents which they cause do not serve to fan the fire and allow it to get out of hand.

7. PRACTICAL APPLICATIONS

(a) *Basement Fires* (see also p. 50). In the case of basement fires it is as well to open up all doors and windows, front and rear, on the ground floor so that firemen may enter this floor and cover any shafts leading up from the basement.

In many modern buildings, openings from the basement to the outer air are provided and covered with stallboard or pavement lights constructed in cast iron frames which may easily be broken with a large axe (see p. 123). In sub-basements, enclosed shafts similarly covered sometimes lead direct to the open air and have no communication with the basement—the fireman's entrance.

When smoke shafts from the basement or sub-basement are provided in a building, the positions of the stallboard or pavement lights which cover them are indicated by plates on the external face of the building.

(b) *Projecting Shops*. Skylights over shops projecting from the front of the building line are generally of fire-resisting glass. If a fire occurs in such a shop (p. 79) it can spread to the main building both through the communicating doorways and through any open upper windows on the frontage, when the fire is released by opening the skylight. To obviate this, water should, of course, be directed on to the fire at the earliest practicable moment, but attention should also immediately be given to closing all doors and windows on the face of the building. When this has been done, the skylight (if it has not already given way) should be opened, and the fire on the ground floor attacked from both front and rear.

(c) *Tube Railways*. Ventilation on tube railways is effected in two ways, by means of fans and by the action of trains passing rapidly through the tunnels.

In the event of a fire occurring and causing smoke in the stations or in tunnels, the assistance of the Transport Authority's staff should be sought, so that fans may be operated to the best advantage.

(d) *Theatres and Cinemas*. These buildings are often provided with lantern lights over stage and projection rooms (see the Chapter on "Special and Unusual Risks"). Where a fire occurs in such a place, the first action should be to operate the release gear if this has not already functioned automatically, and thus allow the smoke and flames to vent upwards, preventing them from entering the auditorium or spreading to the wings. It need hardly be added that under no circumstances should such lanterns be covered by

curtains, shutters, etc., which might interfere with their proper function.

(e) *Mechanically Ventilated Buildings.* Many large buildings are provided with mechanical ventilating systems, some of which are reversible. Details of the various types of system are given in the Chapter on "Building Construction." The earliest opportunity should be taken to get in touch with the Engineer, who will be able to advise on the working of the plant, and operate it as required by the officer in charge of the fire. No attempt should ordinarily be made by the Fire Service to work such a plant, since an error may result in the uncontrolled spread of the fire.

SALVAGE

SALVAGE, as applied to firefighting, is essentially the prevention or reduction of damage from indirect causes such as heat, smoke, water, falling debris, breakage and dirt. Damage caused through fire can be classified either as direct or indirect. Direct damage is caused by actual burning, and it is the work of the fireman to save goods and property from this damage by extinguishing the fire. Indirect damage is caused by the heat and smoke generated, as well as by the water used to extinguish the fire. The prevention or the reduction of indirect damage and, where necessary, the removal of property threatened directly by the fire, are primarily the responsibility of the salvage squad, but every fireman should take all possible steps to assist in work of this kind. Salvage extends beyond the limits of firefighting, and that instinctive regard for the property of others which is the hallmark of a good salvage-man should also be found in every fireman.

The work of salvage on behalf of the Insurance Companies is carried on by the Salvage Corps which operate in the three cities of London, Liverpool and Glasgow. Grouped together within and around the boundaries of these great ports are large numbers of warehouses, stores and industrial premises, and, while the Salvage Corps can, and do, operate in the surrounding areas, it is within the limits of these cities that their work is chiefly confined. Their work is supplemented in these cities by the National Fire Service which, throughout the country, carries out salvage operations with Fire Service personnel and equipment. Firemen engaged on salvage duties normally wear some distinguishing article such as a white armband and/or waterproof coat so that they may not be confused with those engaged in firefighting.

I. EQUIPMENT

The principal items of equipment which may be employed in salvage operations are set out below:—

Salvage sheets in various sizes; those most commonly employed being: 15 ft. by 12 ft., 12 ft. by 12 ft., and 12 ft. by 10 ft.

Rolls of roofing material which can be readily cut to shape.

Sawdust (usually stored or carried in 28-lb. sacks).

Dollies of various types.

Drain rods for cleaning choked drains.

Brooms.

Mops.

Squeegees.

Buckets.

Scoops (dustpans) with sponges for mopping up small quantities of water.

A variety of nails including salvage nails, roofing nails, clout nails, hook nails, and assorted nails, 1-in., 2-in. and 3-in. size.

Sledge hammers.

Claw hammers (1 lb.).

Augers (1½ ins.).

Hand saws.

Picks.

Shovels.

Large axes.

Crowbars.

Cold chisels.

100-ft. lines.

Oil (usually stored in 1-gal. tins).

Paraffin (ditto).

Rags for use with oil and paraffin.

Asbestos gauntlets.
 Rubber gloves.
 Hurricane lamps (carried as a war-time measure by N.F.S. salvage

tenders. Owing to possible dangers electric lamps are to be preferred).
 Electric hand lamps.

Additional items may be carried for dealing with local requirements such as cotton hooks, hay knives, drag forks, pitchforks, etc.,

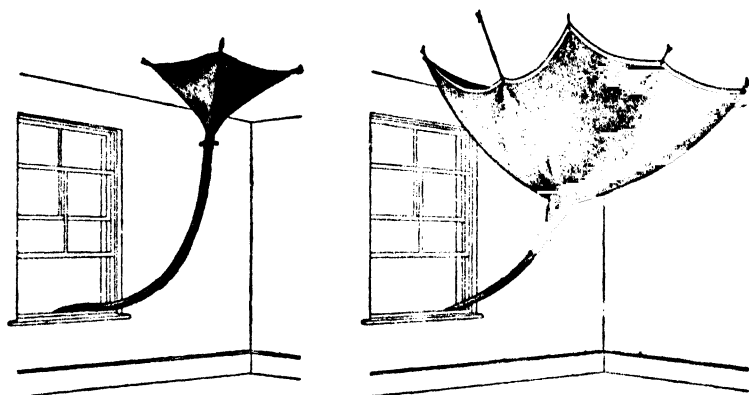


Fig. 1. Typical canvas hoppers. Left : small rectangular type for slinging beneath a hole cut in the floor above. Right : larger type to take water from damaged ceiling.

whilst floodlights are also an important item.

In some localities various types of hopper (Figs. 1 and 2) are employed for catching water and delivering it into a length of hose through which it can be directed outside the building. These hoppers are fitted with a hose coupling (a female coupling being employed to prevent any possibility of the hose being mistaken for a broken firefighting line and coupled up to a pump or hydrant) and may be square or rectangular in shape. One type is constructed so that it can be secured around a pillar, whilst another (Fig. 2) can be pinned to the underside of the nosing of a tread for collecting water running down a stair-

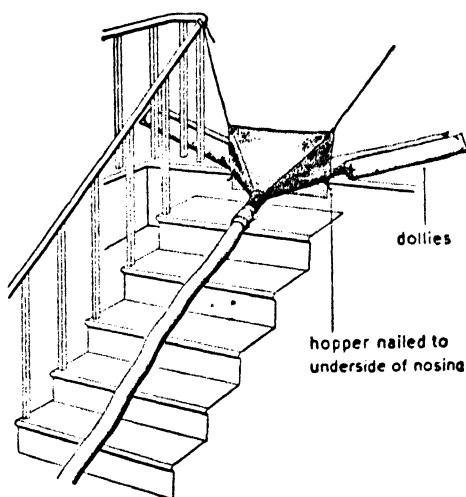


Fig. 2. Staircase hopper in use, showing the method of directing water into the hopper.

case hopper in use, showing the method of directing water into the hopper.

case. Drain guards of wire mesh (Fig. 18) are carried on certain Salvage Corps appliances.

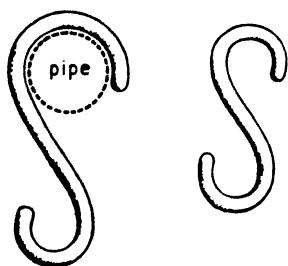


Fig. 3. Typical salvage hooks.

"S" hooks (Fig. 3), one type of which has an end curved to a relatively small radius for attaching to the lanyards of sheets and the other to a larger radius for hooking over pipes, etc., are also sometimes found. In addition, certain salvage tenders carry a light portable pump with 2-in. suction for use in clearing water from flooded basements, etc. This equipment should preferably be carried on a 30-cwt. or 2-ton vehicle fitted with a suitable body.

(a) *Salvage Sheets.* Two types of salvage sheet—rubberised sheets and canvas sheets—are used by the National Fire Service.

(i) *Rubberised Sheets.* The rubberised sheets, which measure 12 ft. by 10 ft. and weigh 15 lbs., are constructed of extremely pliable canvas backed with rubber and can easily be handled by two men. They are used for protecting delicate goods and furniture, and may

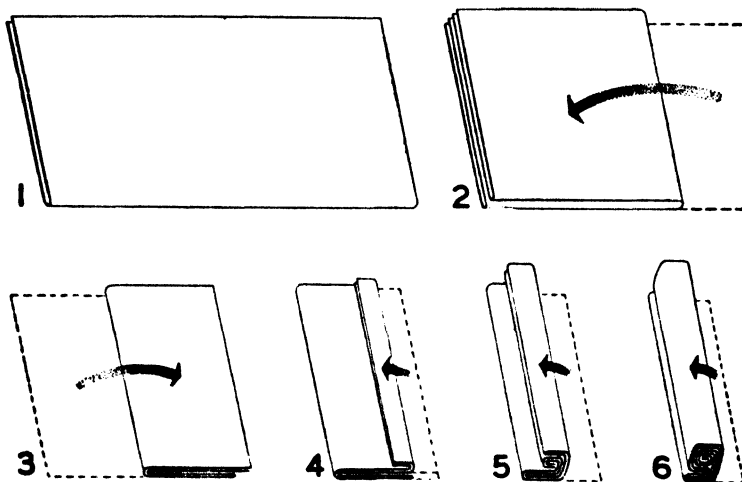
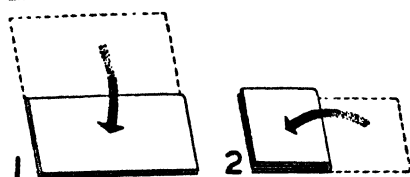


Fig. 4. One method of folding a rubberised canvas sheet.

be used with advantage in private houses. They are stowed in flat folds, one above the other. Two alternative methods of folding are illustrated in Figs. 4 and 5.

The first method is as follows :—

The sheet should be spread out with the canvas side uppermost and the seams running from left to right. Two men take hold of one side, fold in half as in Fig. 4 (1), and quarter it by folding again (Fig. 4 (2)). The quartered sheet is then folded back so that it



NOTE: positions 1 & 2 are drawn four times as small as the remainder

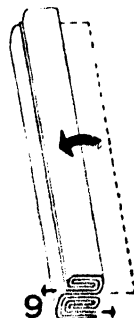
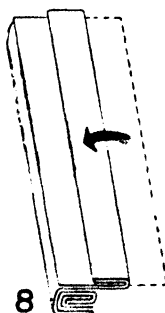
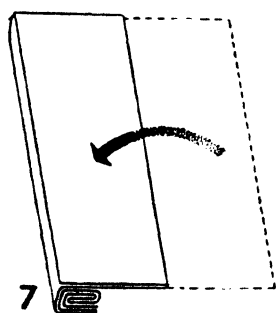
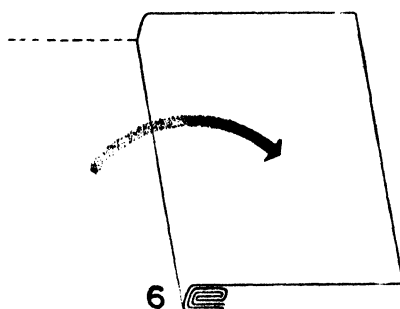
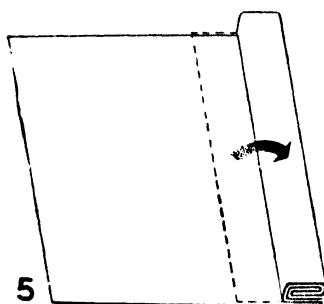
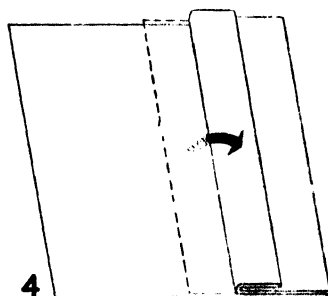
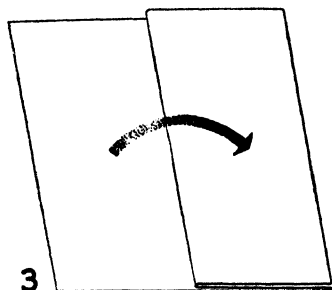


Fig. 5. Alternative method of folding a rubberised canvas sheet.

overlaps the lower side by 9 ins. (Fig. 4 (3)), and this 9-in. overlap is turned back flush with the bottom (Fig. 4 (4)), with the lanyards

(if fitted) inside. The whole sheet is then folded over (Fig. 4 (5)) and then over again (Fig. 4 (6)). Several sheets folded in this way can conveniently be carried at once, flat over the shoulder.

The second method is similar in essentials, but the overlap is omitted and additional folds are made, thus reducing the width of the sheet when folded.

The sheet is first folded in half (Fig. 5 (1)) and in quarters (Fig. 5 (2)); one half of the quartered sheet is then folded back upon itself (Fig. 5 (3)) and the fold thus produced is first halved (Fig. 5 (4)) and then quartered (Fig. 5 (5)). The remainder of the sheet is then folded over on top of the existing folds (Fig. 5 (6)), folded back upon itself (Fig. 5 (7)), and then halved (Fig. 5 (8)) and quartered (Fig. 5 (9)) as before.

The advantages of this method are that a narrower fold is produced, thus allowing two sheets to be laid side by side in an appliance locker, and that the sheet can be immediately opened out by grasping the two ends and pulling them. A particular method of throwing the sheet (Fig. 11) is also used in conjunction with this method of folding.

Rubberised sheets are repaired by patching, using either rubber solution or, preferably, a vulcanising outfit such as is used for hose (see Part 1, p. 54). Large patches applied with rubber solution should be sewn round their edges, to prevent them peeling off when they come in contact with hot water. Care should be taken when stitching, that too large a needle is not employed and that the thread used is of sufficient size to fill the hole left by the needle, as otherwise water might leak through the holes caused by stitching.

The application of the patch is carried out in exactly the same way as mending a puncture, and presents little difficulty. A sufficient area round the tear should first be cleaned with a rag damped with petrol, and allowed to dry. Rubber solution should then be put on, the edges of the tear drawn together, and a patch of suitable size (cut from a condemned sheet) applied. When the solution is dry the sheet should be turned over and a similar patch put on the reverse side of the tear. The whole patch should then be sewn round its outer edge.

(ii) *Canvas Sheets.* The canvas sheets are issued in two sizes, the larger measuring 15 ft. by 12 ft. and the smaller 12 ft. by 12 ft. They are made of heavy waterproofed cotton canvas and weigh 28 lbs. and 23 lbs. respectively. They are somewhat heavier and less pliable than the rubberised sheets, but two men can easily manipulate them. They are primarily for use in bulk salvage operations, particularly for the protection of cases and crated goods and for effecting the temporary covering of roofs, broken skylights, etc. The larger (15 ft. by 12 ft.) sheets may be folded as shown in Fig. 5, or alternatively may be rolled into a cylinder and stowed on end. They should not be stowed one above another. The usual method of rolling the sheet (Fig. 6) is as follows:—

The sheet should be spread out flat. If it is waterproofed on one side then this should be uppermost. Two men each take hold of one end of the sheet at the points (a) and fold it over and then back upon itself in such a way that the resulting fold is approximately

one-seventh of the total length of the sheet (Fig. 6 (1)). The sheet is then held at each side of a point (*b*) (about four-sevenths from the end of the sheet) and drawn back upon the portion already folded as shown in Fig. 6 (2). The remaining portion of the sheet is then grasped at (*c*) and folded in the same manner (Fig. 6 (3)) and then rolled. To form a neat roll one end of the folded sheet should first be turned in for a distance of about 18 ins. (Fig. 6 (4)) and the other

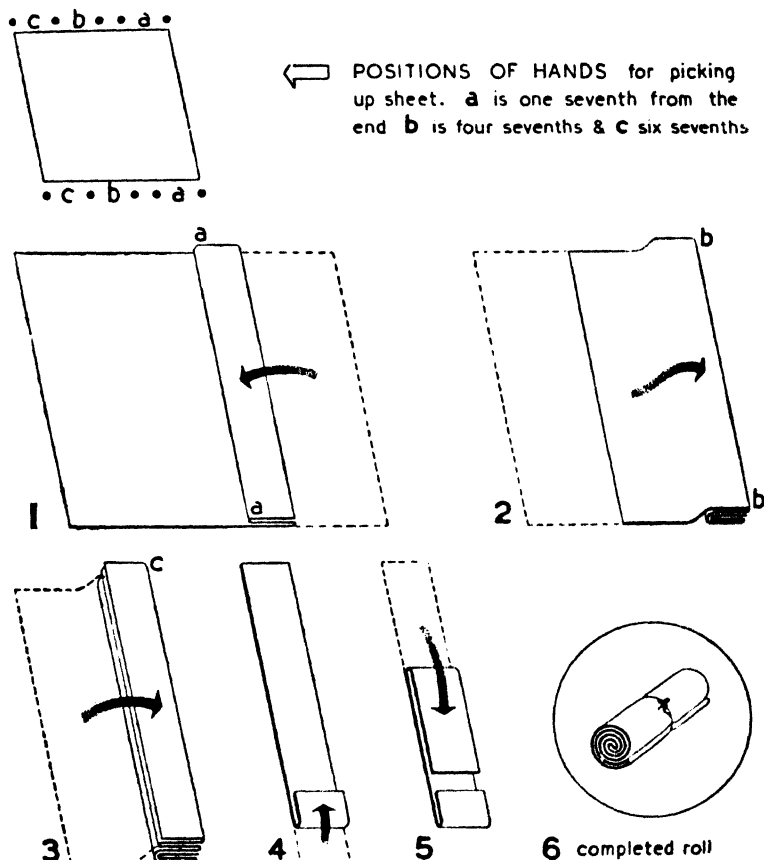


Fig. 6. Method of rolling a canvas sheet or tarpaulin. Note that the top sketch and the inset are not to the same scale as the other drawings.

end turned in so that there is a sufficient clearance between the two folds (Fig. 6 (5)) to prevent their overriding when the sheet is rolled. The sheet is then rolled up and the cylinder so formed tied with a lanyard (Fig. 6 (6)) and stowed on end. The knot used must be secure, but must be capable of being readily undone. A running knot (see Chapter 39) is the best knot to employ. The rolled sheet can conveniently be carried on the shoulder. The reason for folding

the sheet in this manner is that when unrolled and placed on the ground it can be quickly and easily spread to its full extent by holding the uppermost corners and pulling out. Canvas sheets can be simply and quickly repaired by sewing on a patch with a sail-maker's palm, needle and twine.

(iii) *Lanyards*. Each of the eyelet holes on the sheets is provided with a lanyard by which it may be secured. The length of the lanyards varies to some extent but is usually about 3 ft. At one end, the lanyard is provided with an eye splice. It is affixed to the sheet by reeving it through the eyelet hole, then through the eye of the splice and drawing tight. This arrangement enables the lanyards to be removed or attached in minimum time, and several lanyards can also be removed and knotted together to give any additional length which may be required.

(iv) *Salvage Nails*. Special nails (Fig. 7) are used for fixing the salvage sheet. These are of great strength, to withstand the weight of the considerable amount of water that may be caught in the sheet. They are 4 ins. long and may be of several types. One (Fig. 7 (i))

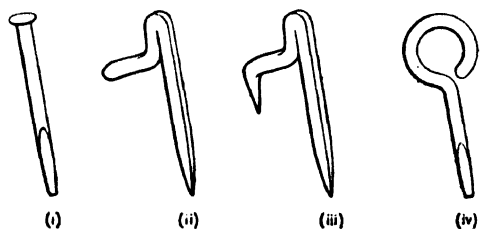


Fig. 7. Typical nails employed for salvage work.

has a head larger than the sheet eyelet, and others (Fig. 7 (ii) and (iii)) are so designed as to be used for securing the lanyards, one type being also slightly hooked so as to permit of securing the eyelets. Another type (Fig. 7 (iv)) has an eye large enough to permit a line to be made fast. This type can also be used as a temporary fastening to a door which has been broken open in such a way as to damage the lock. One nail is driven into the edge of the door, and a second nail driven through the eye of the first into the jamb. In practice lanyards are used with all these types, and it is not normally desirable to dispense with lanyards by nailing direct through the eyelet, since the sheet cannot then be removed without withdrawing the nails, and if a sheet has to be removed in a hurry there is a possibility of its being torn.

(v) *Care of Salvage Sheets*. The fireman engaged on salvage duties must care for his sheets in the same way that he would his hose. They are his most important implements and the success of his operations is dependent upon them. As many as 200 or 300 sheets may be used at a fire involving the top floor of a multi-storey warehouse of reasonable size. The smallest tear in the sheets must be repaired at the first opportunity. A torn sheet should be removed from the appliance until it has been repaired. When the sheets are in use great care must be taken to avoid pulling them over sharp edges and projections where they might become torn. They must never be nailed or fastened save through the eyelet holes. They must not be spread over jagged edges of

broken glass, nor should they be used to cover floors where they would be frequently walked on.

After use, sheets must be carried out of the building and should not be thrown from upper storey windows or rolled downstairs, etc. Upon return to the station the used sheets must be washed down as soon as possible (particularly if they have paint, oil or other substances adhering to them) and hung to dry, if possible under cover but exposed to air currents. If natural drying is impossible canvas sheets can be artificially dried under the same conditions as hose, provided the temperature does not exceed 90° F. After they are dry the sheets must be examined, carefully repaired where necessary, folded and re-stowed on the tender. Sheets which are not used must be opened out, aired and examined every month. Canvas sheets are susceptible to mildew just as is hose, and many of the remarks made in Chapter 4 in the case of hose apply with equal force to the sheets.

Sheets should be marked on all four corners with the appropriate

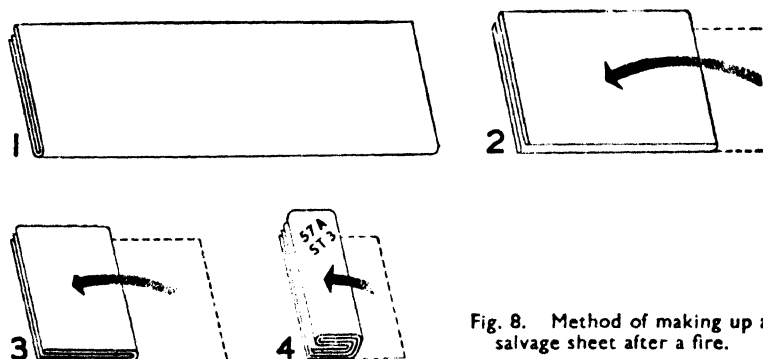


Fig. 8. Method of making up a salvage sheet after a fire.

station or other marking, and when made up after a fire should be folded as shown in Fig. 8. This will indicate that they are in need of cleaning and drying and, since the marking is immediately visible, will make possible the rapid identification of sheets belonging to various stations when sorting out gear after a large fire.

(vi) *Stowage of Sheets.* In normal salvage operations, the largest number of visits by members of the crew to the appliance are made for the salvage sheets, and the primary consideration in the stowage of a tender must therefore be the accessibility of the sheets. The usual arrangement is for the sheets to be stowed in racks along the sides of the vehicle. In this way the first sheets to be used can be lifted out without entering the tender. After the front sheets have been taken, a member of the squad should move the remaining sheets from the interior into the vacant positions ready for use.

(b) *Other Gear.* This is generally stowed behind the driver's cab either on deep shelves or else in the locker space. Shelves or racks can often be constructed above the sheet racks to hold such items as hand saws, scoops, lamps, brooms, and squeegees.

(i) *Roofing Material*. This is used for effecting temporary repairs to roofs and broken windows, and generally for weatherproofing the premises until proper repairs can be carried out. It is cut to size with a knife and fixed in position with roofing felt nails, which differ from ordinary nails in having an extra large head.

(ii) *Dollies*. Dollies are used to dam up doorways and other small openings which the water must be prevented from entering. The regular Salvage Corps make up dollies from gunny (Fig. 9 (ii)) approximately 3 ft. or 6 ft. in length and about 5 ins. to 6 ins. diameter, which are then filled to seven-eighths of their capacity with sawdust. On becoming saturated the sawdust swells and fills

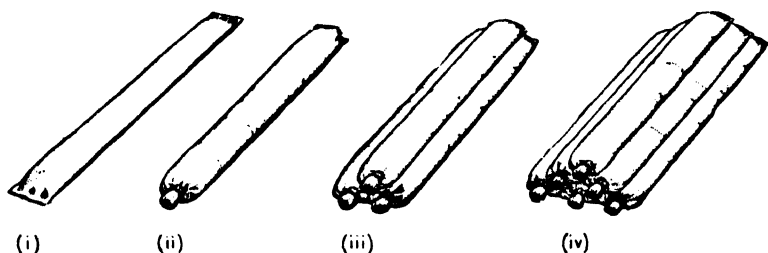


Fig. 9. Typical salvage dollies : (i) improvised type made from condemned rubber-lined hose. (ii) Gunny bag type. (iii) and (iv) Method of piling dollies to form a dam if depth of water is too great to be held back by a single dolly.

the bag, which remains flexible and may be moulded into the shape of the opening it is desired to protect.

These dollies, though very suitable for the work, have the disadvantage that they are somewhat troublesome to make, fill, empty and clean. As an alternative, lengths of condemned rubber-lined hose partly filled with sand (Fig. 9 (i)) may be used. These only need to be washed down and dried after a fire and, unlike the gunny dolly, do not need to be refilled after use. Sawdust cannot be satisfactorily used as a filling for rubber-lined hose since the dolly would tend to float and wash away out of position.

Double dollies (Fig. 9 (iii)) will normally be sufficient to check the flow of water, but dams of piled dollies (Fig. 9 (iv)) can be built up if the depth is greater.

(iii) *Brooms, Squeegees, etc.* These are all employed for sweeping water along channels formed by the dollies and for getting rid of, and drying off, water generally, whilst sawdust is invaluable for soaking up water.

2. PROCEDURE AT FIRES

The officer in charge of a salvage squad attending a fire must rely on his own judgment, since it is impossible to lay down any hard and fast rules for salvage work. A big fire may offer little scope for salvage work, whereas one which calls for relatively little effort on the part of firefighting personnel may provide much work for the salvage crews. For instance, a fire at which sprinklers have actuated may not demand a large attendance of fire appliances,



Plate 33. Well-covered goods on the floor below a serious fire. Note the sheets slung to form a chute to catch water from holes cut in the floor above and discharge it out of a window. A corner of the sheet in the foreground has been turned back to show how, unless goods are stored on "dunnage," it is almost impossible to avoid some damage through water which collects on the floor in the early stages of the fire.



Plate 34. Well-covered stacks of goods. Note overlap of upper sheets to throw off moisture and bucket set to catch drips.



Plate 35. Covering of goods on lower floor, showing tent-like formation of stacks to allow water to drain off. Note also sawdust on floor to soak up moisture.



Plate 36. Gangway cut through half-burnt debris to allow water to drain down from the stacks on either side. A plank has been prised up at the far end to allow water to discharge. Note sawdust which has been laid to absorb remaining damp.



Plate 37. The room immediately below that shown in Plate 36. The sheets have been partly removed to show the undamaged condition of the packages. Note goods stacked almost to ceiling, making the placing of sheets extremely difficult.



Plate 38. Machinery sheeted after a fire in order to protect it from damage by the elements.

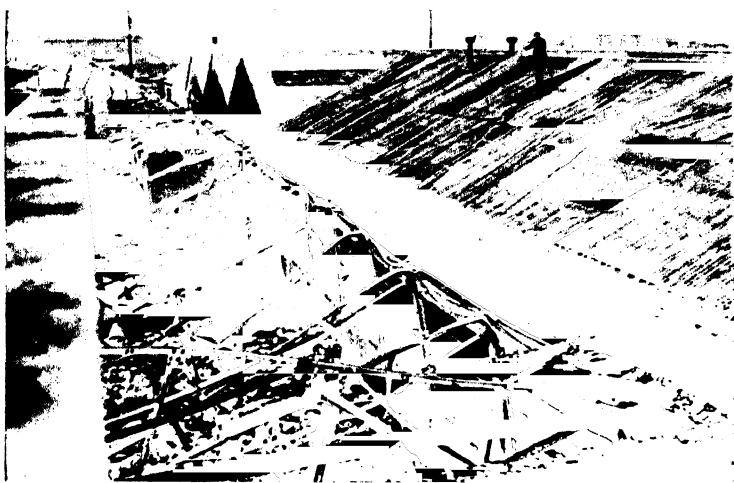


Plate 39. Sheeting of a large area of roof to protect the contents from damage by the elements. Note the use of lanyards knotted together to hold down the sheets. This photograph shows a first-class example of how, with correct fire-fighting, even a narrow alley (10 ft. wide) can be used to form a stop. A number of branches were operated from the ridge of roof to act as drenchers whilst others were directed on to the heart of the fire.



Plate 40. Sheeting of stock shelves in a basement, showing (on left) the difficulty of sheeting when shelving continues to ceiling. The lower sheet has been removed from shelving on right to show the condition of stock.

but the water distributed may mean that much salvage work is necessary. It will generally be the case that a fire in an upper floor will afford greater scope for salvage operations than one lower down in the building. During his survey, the officer in charge of salvage should be accompanied by a member of his crew, who will then be able rapidly to pilot the remaining salvagemen to where they are to work. The occupier, if present at the outbreak, may be able to indicate any items of particular value to which he wishes priority attention to be given and, subject to general over-riding considerations, his wishes should be met as far as possible.

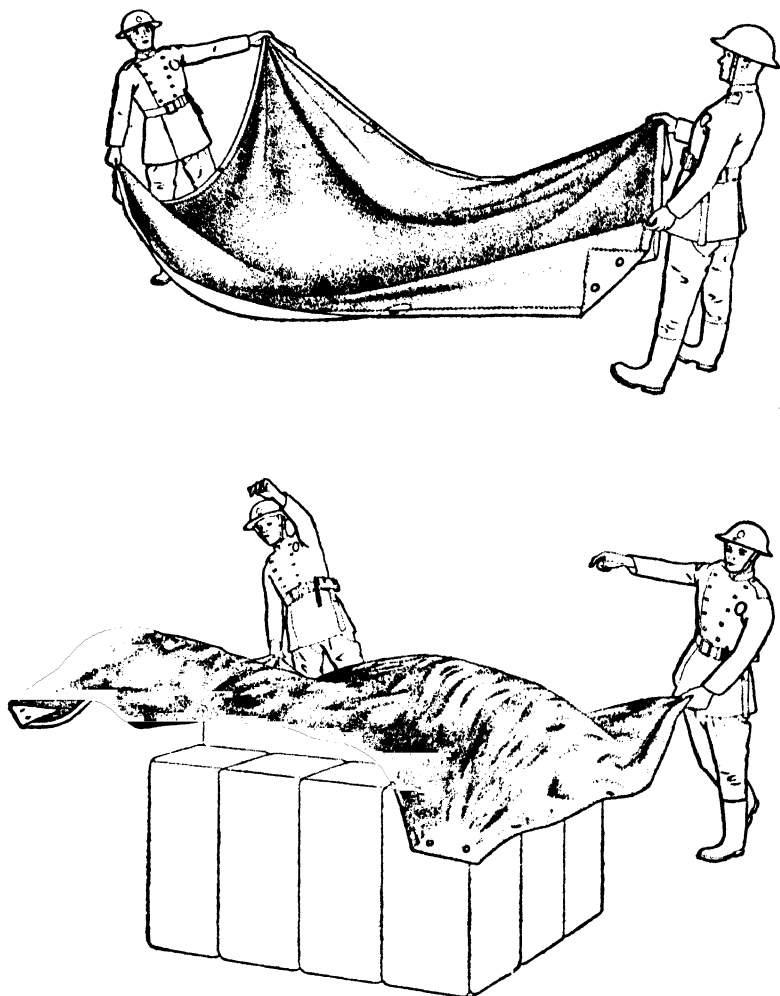


Fig. 10. Sketch showing one method of throwing a salvage sheet. Above : method of holding sheet. Below : method of covering goods.

(a) **Covering Up.** If the salvage officer, on arriving at a fire where an upper floor is alight, is satisfied that the fire will not come into the room immediately below, he should instruct his men to cover its contents with sheets. If he is in doubt but decides to sheet up the room below the fire, he should be prepared to withdraw his sheets quickly. Upon entering the building each salvageman should take with him as many sheets as he can conveniently carry. Men should work in pairs when covering goods, since it is almost impossible for one man to unfold and effectively spread a sheet. One way of "throwing" a salvage sheet is shown in Fig. 10. The sheet is opened out until it is folded in half only, and is extended, one man holding each end, alongside the goods to be covered. Each man then stands at right angles to the goods, and takes some 2-3 ft. of the sheet in the hand which is nearest the goods (Fig. 10, *above*). The other end of the sheet is held in the outside hand. Both men working together then cast the end of the sheet upwards and over the goods with their outside hands (Fig. 10, *below*).

An alternative method may be employed if the sheet is folded as shown in Fig. 5. The sheet is first opened out by taking hold of the ends marked with an arrow (Fig. 5 (9)) and drawing them out. The sheet will then be folded in half only, and the men, one standing at each end of the sheet, each hold the top of the fold in their left hands (Fig. 11) and open out half the sheet, holding the corner in their outside hands. The other half of the sheet is allowed to fall vertically beside the goods to be covered. The sheet is then thrown over the goods in the manner shown in Fig. 10.



Fig. 11. Sketch showing the method of throwing a salvage sheet which has been made up as shown in Fig. 5.

If more sheets than are immediately at hand are likely to be required it is preferable to detail two men to continue covering up while the remainder of the crew provide the sheets.

Considerable ingenuity may be necessary in securing salvage sheets in position. In the case of simple stacks, the upper sheets will probably lie on top of the stack without difficulty, but it may be necessary to use lanyards to prevent the lower sheets from slipping out of position. Similarly, it may be necessary to sling sheets to protect goods, and advantage should be taken of all projections, pipes, beams, etc., to which lanyards can be secured. Where there are no such projections it will be necessary to employ salvage nails driven into the woodwork.

If, by the time the salvage squad arrives at the fire, certain goods are already seen to be seriously damaged, it will usually be wise to neglect these and pay attention to less damaged goods. Thus, for

example, if the stock on the floor immediately below the fire is already badly damaged, sheeting should commence on the floor next below. The lower floors are then sheeted in turn, working downwards, since there is a greater prospect of saving stock on these floors.

If the assistance of other salvage crews has been asked for, the additional men should, on arrival, be despatched to the lower floors to commence or assist in covering up.

(i) *Stock, Machinery, etc.* The covering of stock and machinery is the first and foremost part of salvage work in commercial premises and, to be effective, should be carried out as speedily as possible. As the stock is covered, the crew or crews should proceed to the floors below in turn and repeat the process.

Any stock found on the floor should, as soon as possible, be lifted on to counters, benches, shelves or any improvised supports and covered up. This is of great importance, since it is impossible to prevent a certain amount of water at times from reaching the floor, and if goods are lifted even a few inches off the floor,

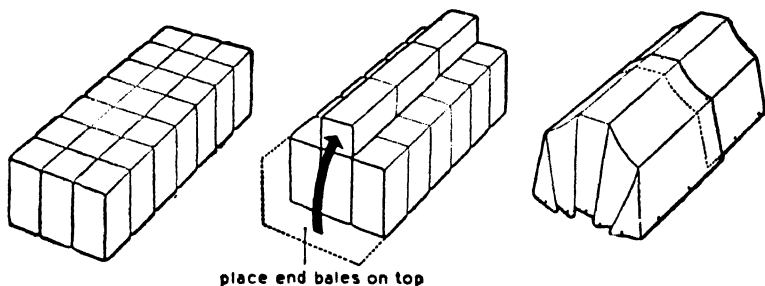


Fig. 12. Diagrams showing one method of improving a ridge so that water will not collect on top of stacked goods.

damage through water coming into contact with the lower parts is obviated. In Plate 33 (facing p. 204) is shown a good example of damage caused in this way in spite of very efficient covering up.

Goods should not be moved from the building while the fire is in progress, save in very exceptional circumstances, for this may seriously hinder firefighting operations and obstruct vital gangways. If goods are removed they should be sheeted up outside the premises, to protect them from the weather and from the water used in firefighting operations. If furniture is moved outside, any cupboards, desks, etc., should be stacked with doors and drawers to the centre of the stow, as a safeguard against pilfering.

Sheets should be spread with care and not thrown over some pointed object which may tear them. They should be spread in a manner that will allow the water to run off and should not be allowed to form a receptacle for the water. Chairs or other similar objects placed on top of a stack of goods will often assist in giving a tent-like effect (Plates 34 and 35) which will throw off the water, or bales of goods may be lifted and placed on the top of a stack (Fig. 12) to achieve the same effect. The first sheets should be

placed over the top of the stack as quickly as possible, so that dripping water cannot get at it. The remaining sheets are then applied and secured under the first sheets so that the latter overlap. The larger sheets are usually of sufficient size to cover the top of stacks and the smaller sheets can then be used to protect floor level. Alternatively, in the case of a smaller stack, two larger

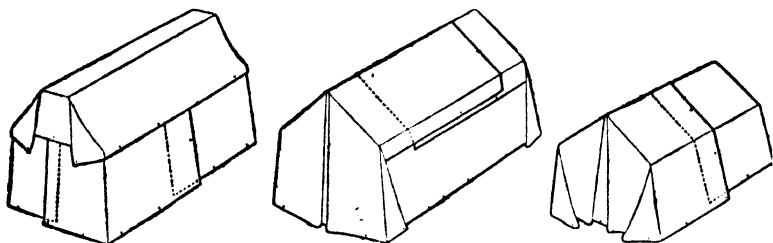


Fig. 13. Diagrams showing various methods of arranging salvage sheets to provide an overlap.

sheets can be overlapped sufficiently to protect to floor level. Various methods of overlapping sheets are shown in Fig. 13 and Plate 34.

(ii) *Furniture and other Movable.* In a private house, hotel, etc., the furniture should, as far as possible, be piled in the centre of the room and care taken to avoid sharp projections or edges which may

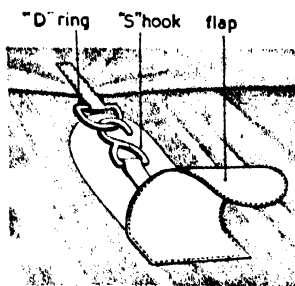


Fig. 14. Sketch showing "D" rings and "S" hooks used on some salvage sheets to join them together so that they overlap.

be the cause of damage to the water-proof sheets. The stack should not be taken to the ceiling, and sufficient room must be left to manipulate the sheet. If carpets are laid loosely on the floors they should be rolled up and stacked with the furniture. If they are already affected by water they should be hung out of windows, the windows being then closed so that the sash will hold them in position. This will not only get them out of the way, but will also help to dry them. On the other hand a close-fitted carpet should be left down in the initial stages, as it will be found very difficult to raise without tearing, and in addition it will absorb large quantities of water. Where

practicable a sheet should be spread over the carpet to protect it. When sheeting up is completed and more time can be spared the carpet should be carefully removed to prevent debris being trampled into it during clearing-up operations.

In one regular Salvage Corps special fittings are attached to the sheets to facilitate overlapping. "D" rings are secured at intervals to the edge of each sheet, and "S" hooks at similar intervals about

9 ins. from the edge of the sheet. When an overlap is required the "D" rings on the upper sheet are clipped on to the "S" hooks on the lower sheet (Fig. 14). Rubber flaps are fitted to prevent the "S" hooks damaging the sheet when it is folded.

(b) *Removal of Water.* When all the covering up has been done, the next step should be to clear off the water from the floors (Fig. 15). A staircase, lift shaft, or other suitable opening forms a convenient means of conveying water from the upper part of the building, the water being directed to it by means of brooms, squeegees, etc., but first all doorways and other openings which might allow water to escape in other directions must be dammed. For this purpose dollies, sacking or any suitable material obtained locally which will hold back water are used. It may often be advisable to start clearing the water in this way from upper floors whilst sheeting is still in progress at lower levels, since this will reduce the amount of

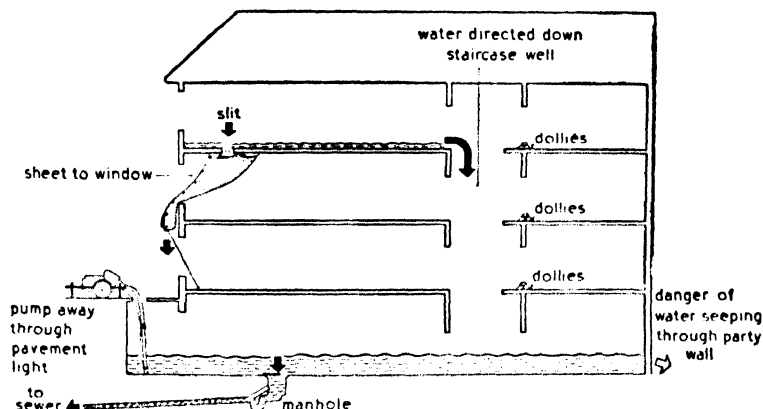


Fig. 15. Diagram showing the various methods of removing water from the upper floors of a building.

water finding its way through floors, but it must be emphasised that water must never be diverted to a floor on which sheeting up has not been completed. At ground level, dams should be arranged to convey the water out into the street or yard, and it is important that all drains should be kept clear; otherwise the water may rise above kerb level and flood adjoining premises.

On upper floors, much time may be saved by cutting a narrow slit or, if this is impossible, by prising up and wedging a floor board. Either of these methods is valuable when an abundance of debris makes the use of brooms or squeegees difficult and will save having to drive the water a considerable distance. The escape holes should be made one above the other at the various floor levels and over a gangway if possible. Several small holes are better than a single large one, and large strips of flooring must not be ripped up, as this may cause unnecessary damage and the risk of persons in the building tripping up or otherwise suffering injury. Slits are pre-

ferably made with a crowbar by driving the chisel end into one of the boards, across the grain (Fig. 16), then making a second cut about 9 ins. along the board and knocking out the narrow strip of wood between the two cuts with the crowbar. The crowbar can

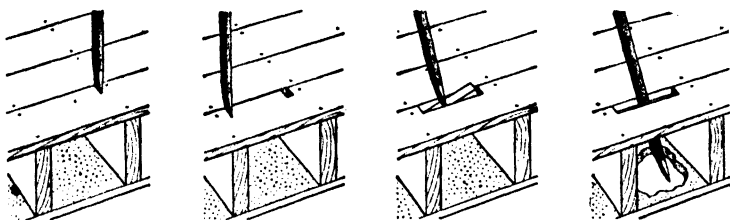


Fig. 16. Sketch showing the correct method of making a slit in the floor to allow water to escape.

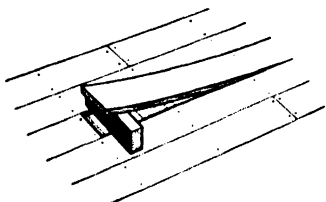


Fig. 17. Sketch showing the method of wedging up a floorboard to allow water to escape.

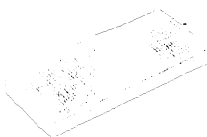
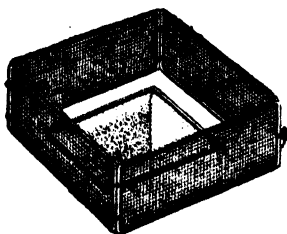


Fig. 18. Wire mesh drain guard used by regular Salvage Corps. Above: opened out to protect a drain. Below: packed for stowing on the appliance.

then be inserted through the slit and used to puncture the ceiling below to release the water. When cutting a slit in this way care should be taken to operate between the joists, the position of which can be seen by the rows of nails. An alternative method is to prise up a board, by inserting a crowbar at the joint of two boards and wedging one of the boards up (Fig. 17).

Where a drain has been made in this way it should be guarded to prevent personnel tripping over it. Any obstacle, such as a chair, will serve as a warning. If it appears likely that the water will continue to drip for some time, a waterproof sheet should be slung immediately below the hole, in order to catch the water and convey it out of a window or into a suitable receptacle. If the drip is only small it may be dealt with by placing a bucket beneath it. If there is a basement to the building, water may already have collected there, and for this reason the manholes, which will be found in most basements, should be uncovered as soon as possible, the covers being left at an angle across the openings to prevent firemen or salvagemen subsequently falling down the manhole. Special wire mesh drain guards (Fig. 18) are sometimes carried to assist in keeping

manholes and drains clear. If these are not available, inverted wicker hampers, baskets, or even wicker basket type trolleys such as are often used for moving goods, have all been found valuable in this connection. In practice any suitable debris can be improvised to form a guard, or at least a warning of the presence of danger.

When working in smoke and with the floor possibly covered with water, it should be remembered that manholes are normally always located close to lavatories, wash houses and rainwater or soil pipes (Fig. 19). Once the probable location has been ascertained in this way the actual position of the cover can only be found by tapping the surrounding floor with a crowbar until it is identified by the hollow sound. Too much force must not be used or the cover may be broken so that it cannot be replaced, and the manhole may subsequently prove a danger to men working in the vicinity. Once found, the cover can be lifted in the normal way.

When, as is often the case, no manholes or drains are to be found in a basement, it then remains to clear the water away by means of buckets and scoops, or, if it is deep, to remove it with the aid of a portable pump.

When using such pumps in a basement the necessity for providing an escape for the exhaust fumes should not be forgotten. It may be possible to form a sump in stone-flagged premises by removing a flagstone and placing the pump suction in the well so formed. Basements often have lavatories situated in them, and it is cheaper to knock away a lavatory pan with a sledge-hammer and thus enable the water to escape down the drain, than to allow an accumulation to remain and damage the commodities and sometimes the foundations of the building. Fire-fighting crews can often assist in emptying a basement by putting down a suction and using the water for fire extinguishing purposes overhead. This also economises in water. Where the depth from which the water must be lifted exceeds the practical pumping lift, a light trailer pump removed from its chassis and carried down below street level may be employed to remove the water through lines of hose to outside drains. Care should always be taken to ensure that the outside drains are kept clear, since all water removed from the building will have to be disposed of through the street drains.

It will often be necessary to clear paths through debris (Plate 36) to serve as a channel for water and to allow the water to drain down to the path from the material heaped up on either side. When

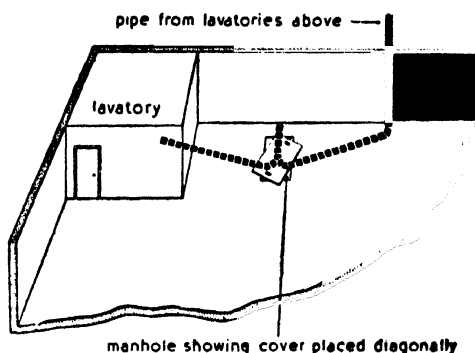
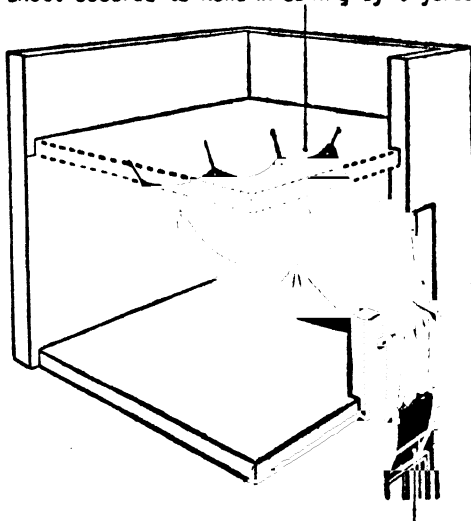


Fig. 19. Diagram showing characteristic constructional features from which the position of manholes in a basement can usually be ascertained.

deciding on the location of such a path the lay-out of the floor below should be investigated, so that the drains which will require to be cut through the floor will be over a gangway or near a window through which the water can be directed by chutes. The effectiveness of such methods, if properly carried out, is seen from Plate 37, which shows the room immediately below that seen in Plate 36.

Openings for pipes and light fittings in the ceilings will probably form a path for the water and should be carefully watched. Buckets should be placed to catch any water seeping through these openings. Ventilating ducts may also serve to carry, for considerable distances, water which finds its way into them during firefighting operations,

sheet secured to nails in ceiling by lanyards



lanyards tied to window below

Fig. 20. Diagrammatic sketch showing the method of using a salvage sheet to form a chute to direct water from the building.

and they should be periodically inspected to see that none is flowing to other parts of the building by this means. Where the water is not running at a fast rate it could be caught by means of a sheet slung with lanyards from nails driven into the walls or ceilings, or by means of a sheet arranged on the floor with the edges rolled up to form a small dam. The chute (Fig. 20 and Plate 33) may be formed by firmly lashing or, if necessary, nailing one end of a salvage sheet to the ceiling. Lines should then be secured to the other end, which should be passed out of the window and pulled taut. If the chute is made in an upper storey the lines can be passed into the window below and made fast; if on the first floor the lines can be made fast to a fence, tree or similar object on the ground outside the building. The special types of canvas hopper previously referred to, if available, can very readily be slung to catch dripping water. These hoppers terminate in a female hose coupling to which a length of hose can be connected to direct the water out of a convenient window, etc.

Again it may be found that water has accumulated between the floor and the ceiling below, and since it will only be a question of time before the ceiling gives way under the weight of the water, a quick release can be effected by piercing the ceiling with a ceiling hook, care being taken to see that goods below are first covered up.

This, however, should only be done when necessary, in order to prevent even more extensive damage. Matchboarding and some types of building board will normally allow the water (provided it is kept down to reasonable quantities by clearing on the floors above) to pass without undue damage.

(c) *Reduction of Water Damage.* If a sprinkler system is installed, one or more heads will probably have operated, and the Fire Service officer will have stationed a man at the stop valve. The salvage officer will wish to contact the officer in charge of the fire at as early a stage as possible to obtain permission to shut off the system and so reduce the water damage. *This action must never be taken, however, without that permission, as it might seriously affect the control of the fire,* for if water is shut off prematurely the fire may break out again with disastrous consequences. If spare heads for the system are carried on the appliance or are available in the building, he should, when firefighting operations are concluded, see that the operated heads are replaced and that the system is recharged and in condition to function again should a further outbreak of fire occur.

Water may also be escaping through damaged water pipes. Such leaks can usually be dealt with by turning off the main valve or tap where the water enters the building, but this may not prevent the escape of water from a domestic cistern. In such cases the cistern ball cock should be lashed to prevent any further water entering the domestic system.

During these operations the officer in charge of salvage should ascertain if any surrounding buildings are affected. Firemen often find it necessary to take lines of hose through adjoining premises, or even into buildings opposite, in order to attack the fire. Hose is liable to burst, couplings may leak or become disconnected, and as a result water will cause damage in such premises. The timely tightening of a screw coupling or the application of a hose bandage may prevent considerable damage. Furthermore, firemen may damage the roofs and skylights of surrounding premises and these may eventually need to be covered with roofing material.

In the event of a basement fire where there are no drains, the water may accumulate and, quite possibly, penetrate the walls on either side, thus causing damage to stock in adjoining buildings. If there is any danger of this occurring, adjoining occupiers should be warned of the possibility of water entering their premises and the consequent necessity for keeping a watch on, and if necessary removing, these goods. It should be pointed out that the danger is not necessarily from a visible or surface flow, but that much damage can be caused by percolation through walls or floors; if necessary, men should be ordered to remove stock from the floors and any fixtures close to the ground in the adjoining premises. Any manholes or drains which may be found should be opened, in the manner described above, to allow the water to escape.

(d) *Reduction of Smoke Damage.* Smoke may cause serious damage to many classes of commodities, e.g., foodstuffs, silks, furs, etc. The officer in charge of the salvage squad should therefore

contact the officer in charge of the fire and enquire whether, and if so what, ventilation may be carried out. *Under no circumstances should any attempt be made at ventilating the premises except with the specific approval of the officer in charge of the fire, and then only in the manner required by him.* Uncontrolled ventilation may have a serious effect on the fire and cause it to get out of hand (see Chapter 37).

(e) **Removal of Sheets.** As soon as water finally ceases falling from above, sheets should be removed in order to allow free access of air to the goods and thus prevent the general dampness of the building from affecting them. Windows and doors should be opened to

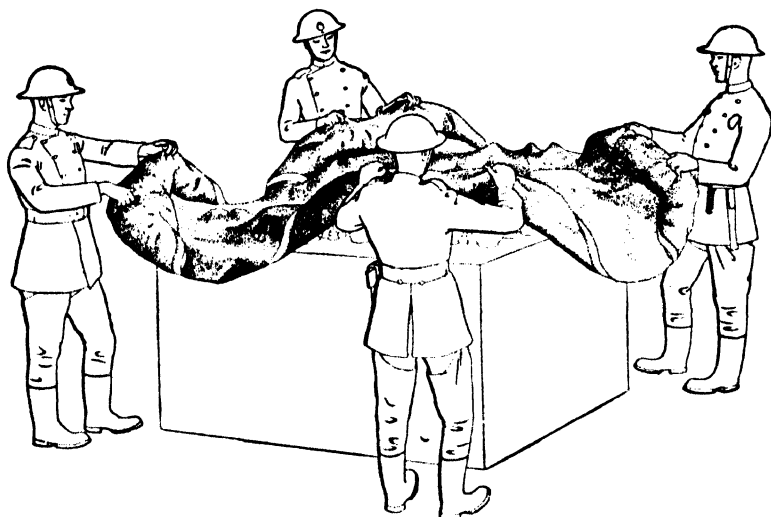


Fig. 21. Sketch showing the correct method of removing a salvage sheet from crockery or other fragile goods.

allow the air to circulate and thus assist in drying off the inside of the premises.

When removing sheets, great care should be taken to dispose of any pockets of water which have accumulated in depressions or hollows in the sheets. The careful work of many hours might well be nullified by the careless showering of such water on stock which had hitherto been well protected.

Care should also be taken when removing sheets from crockery and other delicate articles. The correct method to employ in such circumstances is for four men working together to roll the sheet inwards from its four corners (Fig. 21). When the corners are so far rolled that the sheet becomes square again rolling is continued from the new corners so formed. This action is repeated until the sheet forms a compact bundle in the centre of the stack, when it can be lifted down without any risk of damage to the goods.

(f) **Laying Sawdust.** When all the water has been cleared from

the building or buildings affected, and as far as possible all debris cleared to one side, sawdust should, if feasible, be laid on the floors to absorb the remaining moisture. This is of great importance in the case of parquet floors, which will swell and rise if allowed to remain wet, and are costly to renew. Since water will continue to seep through for some time, the sawdust should be laid more thickly around the edge of the debris. Sometimes this work can only be done during daylight, and if the fire has occurred during the night it may then be necessary to send personnel out next morning for the purpose.

(g) *Drying Off.* Particular attention should now be paid to machinery and furniture. The former is quickly affected by damp and smoke, and, as soon as it is convenient to remove the sheets with which it has been covered, such machinery should be wiped dry, oiled by means of a brush or rag and re-covered with dry sheets or by a sheet slung to allow air to circulate. Delicate machinery may be damaged by using the wrong type of oil and it is frequently necessary to use spindle or some similar high grade oil. The occupiers of the premises should therefore be consulted before machinery is indiscriminately oiled. Machinery should not be wiped over with paraffin and then left without further protection, since rusting will inevitably take place unless lubricating oil is subsequently applied. The danger of cutting the hands on such sharp objects as planing blades, saws, etc., should always be borne in mind.

A very good service can be rendered to furniture if sponges and leathers can be used to remove stains, whilst electroplate, mirrors and similar articles should be carefully wiped over as quickly as possible in order to minimise smoke damage. Drawers can be opened and the inside edges wiped. If they are left open to allow the air to circulate, swelling and jamming are prevented. The waterproof sheets should not be replaced unless water is still dripping from above.

Once all water has been removed it should be suggested to the management that any available form of heating should be turned on to assist in drying out the premises.

(h) *Fatal Fires, etc.* In the case of a fatal fire, or one of doubtful origin, care should be taken not to destroy possible evidence by cleaning up after the fire has been put out or by disturbing debris more than is essential (see Chapter 34). Debris should not be removed from the premises, as it may be required as evidence in support of the claim on the insurance company.

3. PROCEDURE AFTER THE FIRE

The next aspect of salvage work to which the officer should pay attention is that of removing anything that is a source of danger to persons having to move about the premises. For example, broken glass, defective ceilings, loose window-frames and damaged plaster on walls should all be removed.

(a) *Repair of Roofs.* If the weather is inclement and may cause further damage to the building or its contents, the possibility of

hanging salvage sheets to cover the front of the building should be considered. Any machinery which may have been exposed to the elements as a result of damage to the roof should also be sheeted up (Plate 38) to prevent further deterioration.

Where the roof has been damaged it may be necessary to remove

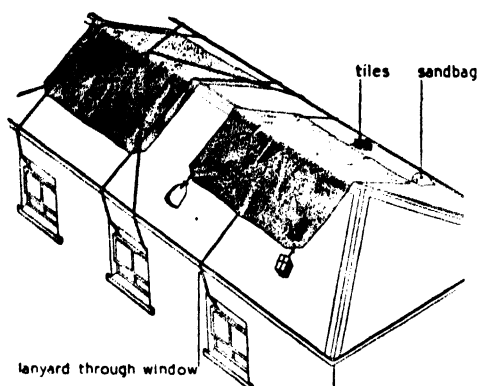


Fig. 22. Sketch showing methods of improvising a temporary roof repair with a tarpaulin or canvas sheet and various methods of securing the sheet in position.

all the goods from immediately below the hole to another part of the building. But if the hole is of suitable size and near the ridge, a tarpaulin should be spread over to form a temporary covering (Fig. 22 and Plate 39). Before the sheet is fastened all pointed nails or sharp objects that could tear it should be hammered flat. The sheet must be firmly fixed in position, as it will be exposed to the elements and a loosely

fixed sheet would quickly become torn from its fastenings. It should be weighted down with parcels of lead, tiles, slates or similar heavy

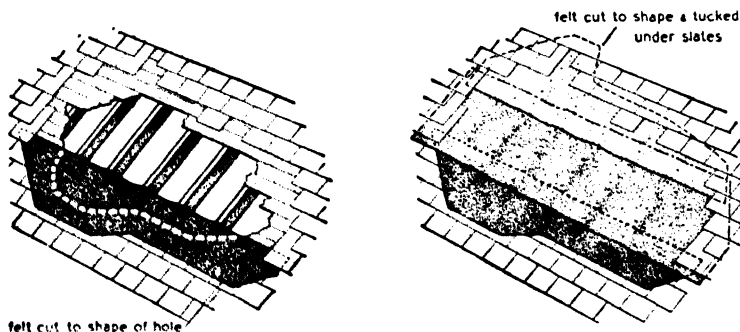


Fig. 23. Methods of inserting roofing material beneath tiles to form a temporary repair. Left: first strip of felt in position. Right: the hole covered with three strips, each lapped 9 ins. over the one below and nailed to the rafters every 6 ins.

objects or nailed through the eyelet holes on to the rafters, and secured by lanyards to the nearest windows. An alternative method is to pass lines over the ridge of the roof, securing these to windows on each side of the house. A sheet should also be used in a similar manner to cover up broken skylights.

If only a small portion of the roof is damaged, this can sometimes be repaired by cutting a piece of roofing material to the requisite size and inserting its edges beneath the tiles on each side of and above the hole, leaving the lower edge projecting to form an overlap.

A more durable repair of a considerable area of damage can be effected by nailing strips of roofing material across the damaged portion, commencing at the bottom and laying each strip so that it overlaps the one below by 8 or 9 ins. (Fig. 23).

(b) Securing Premises against Entry. Finally, there remains the task of securing the premises against intrusion. Doors or windows may need to be boarded up, and the necessary tools are carried on salvage appliances. It is assumed that some suitable timber will be found on the premises, such as packing cases or partly burned partitions. It is often necessary to fix a padlock on a gate or door, and for this reason a supply of padlocks and fittings is carried on regular Salvage Corps appliances. Any cash or valuables recovered during salvage operations should be handed over to the occupier or owner or, if he is not present, to the police, and a receipt obtained.

It will frequently be necessary to leave sheets behind after a fire, but in such circumstances a careful record must be made and the occupier notified of the position. At the same time enquiries should be made as to what steps the occupier has taken to expedite the repairs which will make the withdrawal of the sheets possible.

PART 6A CHAPTER 39

KNOTS, SLINGS, PURCHASES AND SPLICES

LINES form an important item in the equipment carried on Fire Service appliances, and their manufacture, the various types in use, and the necessity for proper care and maintenance, have already been dealt with in Chapter 7. In order to utilise a line to maximum advantage it is essential for every fireman to be fully conversant with each of the standard knots, bends and hitches. He should be able to make each one so automatically that it can be made, as is often necessary, in complete darkness, under difficult conditions of smoke and urgency.

The list of knots, bends and hitches given in this chapter is by no means exhaustive and additional knots may be used, but for normal Fire Service purposes the range described should suffice. Every fireman should be completely familiar with each of these knots and their uses, so that when the occasion arises he will immediately know which is the best knot for the particular job in hand. A brief explanation as to its use is therefore given after the description of each knot.

The correct method of tying a knot is not difficult to master, and, with practice, it will eventually become an ordinary routine in the duties of a fireman. A proportion of the time devoted to practice should be spent with the eyes blindfolded with a handkerchief, in order to attain proficiency in the dark. The practice of tying knots behind the back should not be encouraged as this does not correctly reproduce the conditions which obtain when working in smoke or darkness. Mastery in tying such knots as are possible with one hand only should be sought, whilst practice should also be carried out under difficult conditions such as on ladders or when in the prone position.

STANDARD TERMS

There are many standard terms which are used in connection with lines and the following should be learnt and understood by every fireman.

Bend. To fasten a line to another line or to an object.

Belay. To make a line fast. This is usually applied to running lines.

Bight. The looped or loose part of a line between the two ends.

Crowning. A method of finishing off the end of a line, when extra thickness at the end is not inconvenient, by unlaying the strands and making a crown knot, such as the commencement of a back splice.

Eye. A loop formed at the end of a line by seizing or by splicing.

Hitch. A simple fastening of a line to some object by passing the line round the object and crossing one part over the other.

Mousing. A piece of cord or light line tied across a hook (see

Fig. 24) to prevent the object secured to the hook from jumping out.

Parcelling. The wrapping of a line, or a part thereof, usually with strips of canvas, to assist in preventing its chafing.

Pay Out. To ease out or slacken a line.

Reeve. To thread a line through a block.

Running Part. The moving part of a line which is loose and used to hoist or lower.

Running End. The free end of a line.

Seizing. The binding together of two or more ropes. (Sometimes known as frapping.)

Serving. The protection of a line against chafing by winding yarn on to it against the lay. A line is always served after it has been parcellled.

Splicing. Joining a line by unlaying the strands for a short distance and then tucking the strands of the two parts into one another so that they interlock. A long splice is used when the line is required to pass through a pulley block and a short splice when it is not.

Standing Part. The part of a line which is fixed.

Whipping. The binding of the end of a line with twine to prevent it unlaying.

Worming. Laying a light line within the grooves between the strands of a line in order to give a smooth surface for parcelling.

Great care must be taken of all lines, as it is obvious that the strength of any line is only equal to that of its weakest part. If a line must be passed over any sharp edge during its use, *e.g.*, a window ledge, wall, or coping, some simple protection such as a sack, mat, or even a wooden hose ramp, should always be used to prevent chafing.

When using a new coil of line, the bottom inside end should be taken out first and, if this has not already been done, the line should be stretched (by carrying out the standard test) and the ends whipped or crowned.

After use a line should be cleaned and dried before coiling. It cannot be too strongly emphasised that a line must always be free from knots and kinks. It should never be left hanging but should be coiled and wherever possible laid out flat on the ground, in the locker, etc. Lines should always be coiled in the same direction as the lay, *i.e.*, right handed or clockwise for a right-hand lay (see Chapter 7) and left handed or anti-clockwise for a left-hand lay.

In use a line is always secured to an object, to another line or to part of itself. This is effected by means of a knot or hitch. A number of different knots are available, each having certain specific uses. The requirements of a good knot are :—

(i) that it shall carry out the function for which it is employed, safely and without slipping;

(ii) that it shall be easy to make;

(iii) that it shall not damage the rope;

(iv) that it shall be easy to untie.

KNOTS

In the following descriptions the illustrations have been made as simple as possible, so that they can easily be followed, but it is essential for each fireman to practise tying the various knots until he is satisfied as to his proficiency. Every knot should be tied with a sufficient length of running end. To economise in space this is shown in most of the illustrations as shorter than would be the case in practice.

HALF HITCH

The half hitch is not a true knot but forms part of a number of different types of knot. Its method of formation is shown in Fig. 1 (*left*).

OVERHAND KNOT

The overhand knot (Fig. 1, *centre*) is formed by laying the end over the standing part and then bringing it under and up through

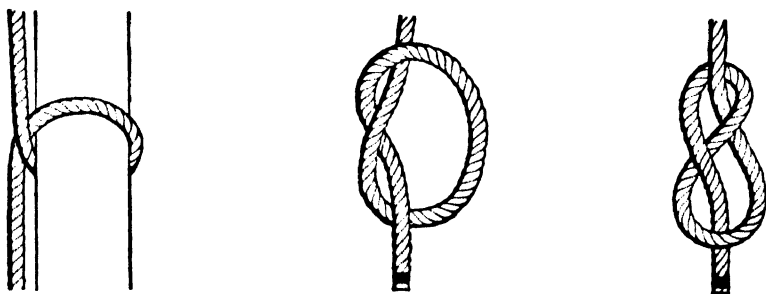


Fig. 1. Method of making (left) half hitch ; (centre) overhand knot ; (right) figure-of-eight knot.

the bight. The knot, which is sometimes known as a thumb knot, is mainly used to prevent a line unreeving through a block. In the Fire Service it is also used to identify a damaged or burst length of hose, for which purpose an overhand knot is tied at one end of the length when it is left laid out (see p. 30).

FIGURE-OF-EIGHT KNOT

The figure-of-eight knot (Fig. 1, *right*) is made by laying the end over the standing part of a rope and then bringing it round underneath the standing part and down through the bight.

The knot is usually put in the end of a line rove through a block to prevent it unreeving.

REEF KNOT

The reef knot is one of the most useful of all knots. Its method of formation can be clearly traced in Fig. 2. Having constructed the knot as far as Fig. 2 (*left*) part (a) must be kept above part (b) and the end (c) led in accordance with the path of the dotted line.

which the strain is to be applied—i.e., if the strain is to the left then the round turn should be made on the left of the standing part and *vice versa*. The use of a rolling hitch in conjunction with a half hitch to hoist an extinguisher is shown in Fig. 4 (*right*).

A rolling hitch is also used in conjunction with a clove hitch for hauling a branch and line of hose aloft (Fig. 6, *left*). For this purpose the rolling hitch is made on the hose some 10-12 ft. from the branch, and adjusted so that when the hose is charged the knot will not constrict the flow. The hose is then allowed to lie in a bight and a clove hitch made either round the narrowest part of the branch or round branch and coupling. When the hose is hoisted, the clove hitch is removed from the branch and the line securing the hose by means of the rolling hitch is then fastened to a firm object, in such a way that the hitch lies well below the coping (2-3 ft.). The line will then take the weight of the charged hose.

TIMBER HITCH

The timber hitch (Fig. 7, *left*) is formed by making a half hitch on the standing part of a line (after passing it round the object to be secured) and twisting the end back again round its own part of the hitch with the lay of the rope.

The knot is used to secure a line for hoisting a baulk of timber, a plank or any irregular object. When used for hoisting spars, etc., the hitch should be used in conjunction with a half hitch (Fig. 6, *right*) at the upper end of the spar, in order to keep it reasonably upright and prevent it catching in obstructions.

ROUND TURN AND TWO HALF HITCHES

A round turn and two half hitches (Fig. 7, *centre*) is formed by making a round turn on a spar or rope, and making two locking half hitches (a clove hitch) on the standing part of the line. The end of the line can then, if desired, be seized to the standing part.

The knot is utilised for securing a line to a spar or any round object, or to another line, and is also frequently used for mooring a boat. It has the advantage that when a heavy weight is applied the knot does not jam, and after the weight is removed is easy to untie.

FISHERMAN'S BEND

The fisherman's bend (Fig. 7, *right*), which is related to the round turn and two half hitches, is made by forming a round turn on the

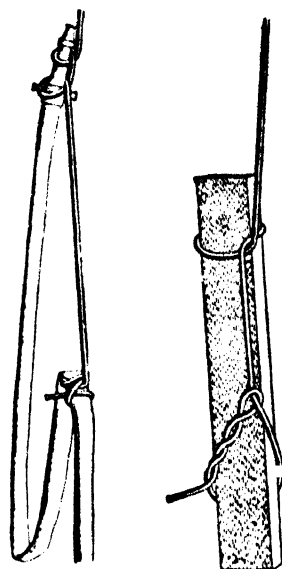


Fig. 6. Left: method of hoisting a length of hose and a branch using a rolling hitch and a clove hitch. Right: method of hoisting a spar, using a timber hitch and a half hitch.

spar or other line to be secured, then making a half hitch round the standing part of the line in such a way that it passes through the round turn. A further half hitch is then made with the end on the standing part. The end should be seized to the standing part.

This knot, like the round turn and two half hitches, is used for

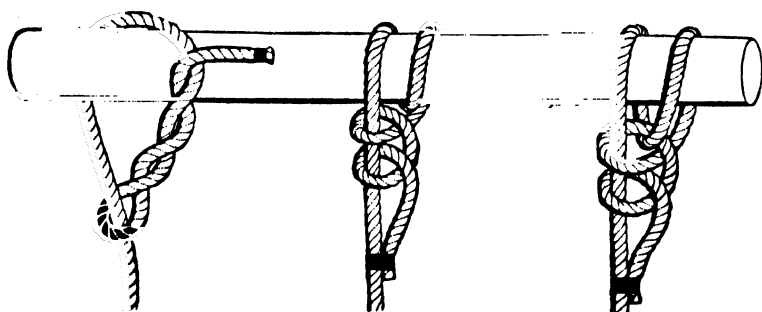


Fig. 7. Method of making (left) timber hitch ; (centre) round turn and two half hitches ; (right) fisherman's bend.

securing a line to a spar or to another line. It is also used in fireboat formations for securing a line to a ringbolt.

DRAW-HITCH

The draw-hitch (Fig. 8) is formed by passing a bight (a) round a spar (Fig. 8, *left*), then forming a second bight (b) on the standing part (c) of the line and passing it through the first bight (a) (Fig. 8, *centre*). A third bight (d) is then formed with the running end (e),

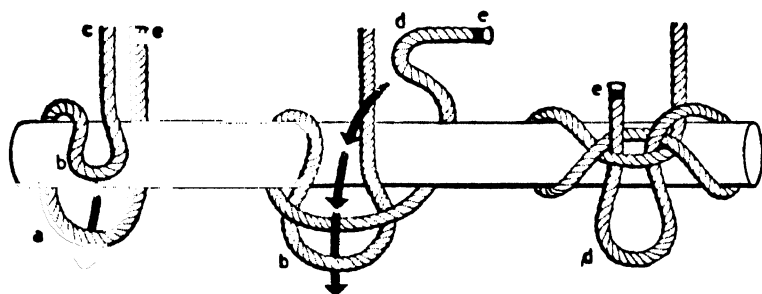


Fig. 8. Method of making a draw-hitch.

passed through the second bight (b) (Fig. 8, *right*) and the whole tightened by pulling on the standing part. At each stage the bights should be tightened as much as possible.

The draw-hitch is reliable on a round spar or ring but not on any square or angular object. It will hold a strain on the standing end and can be released by jerking the short or free end. It is useful for securing an object which cannot subsequently be reached to release the knot or for making fast a boat's painter to a post or ring-

bolt so that it can be instantly released. The running end of the line should, of course, be brought back to the boat.

RUNNING KNOT OR SLIPPERY HITCH

The running knot or slippery hitch (Fig. 9) is made by putting a half hitch on the object to be secured, and pulling a bight (a) of the free end of the line through the hitch. The knot can be released immediately by pulling on the end (b). The slippery hitch is a useful quick-release knot, being simple to make and releasing without difficulty, but it does not hold so securely as a draw-hitch, and is normally only used for a temporary fastening.

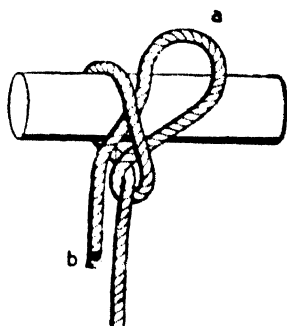


Fig. 9. Method of making a running knot or slippery hitch.

SHEET BENDS

There are two knots of this type, the single sheet bend and the double sheet bend. In making a sheet bend the ends of the two lines are not used simultaneously as in the reef knot, but a bight is first formed in the end of one of the lines and the other line then passed through it.

The single sheet bend is formed by making a bight (a) in the thicker line (Fig. 10, *left*), and then passing the end of the thinner

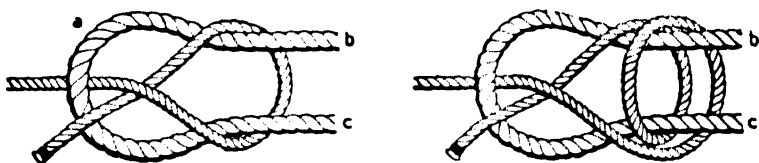


Fig. 10. Method of making (left) single, and (right) double sheet bend.

line up through the bight (a) behind the two parts (b) and (c) of the thicker line and under its own standing part, thus forming a locking half hitch round the thicker line.

The double sheet bend (Fig. 10, *right*) is formed in a similar manner except that the thinner line is given an additional turn round both parts, (b) and (c), of the thicker line, before locking the half hitch.

Both bends are used for tying together lines of different thickness, but the extra turn in the double sheet bend makes it the more secure. A double sheet bend should always be used when tying together wet lines if there is danger of slipping.

CARRICK BEND

The carrick bend is made by forming a bight (a) on the first line (Fig. 11) by passing the running end (b) back and under the standing

part (c). The running end (d) of the second line is then passed up through the bight (a), down between the running end and standing part of the first line, and up again through the bight (a) on the left of its own standing part. The running end of each line is then seized to its own standing part. Care should be taken when tying

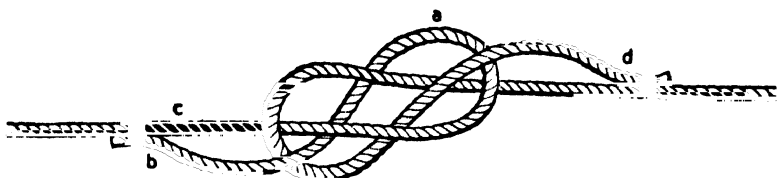


Fig. 11. Method of making a carrick bend.

a carrick bend to ensure that the end (d) is led on the *left* of its own standing part. If it is taken on the right the result will be a granny knot, with which it is often confused.

The carrick bend is used to join two lines together, especially when the knot may be required to pass around a post, since it lies evenly and does not form an obstruction to the paying out of the line.

SHEEPSHANK

A sheepshank is formed by gathering up the amount by which it is desired to shorten the line as shown in Fig. 12 (*above*). Half

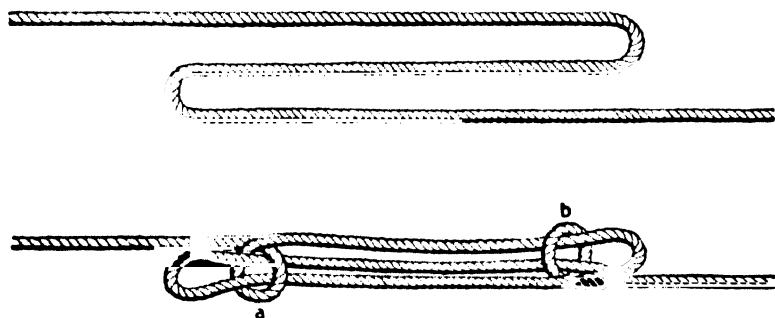


Fig. 12. Method of making a sheepshank.

hitches (a) and (b) are then thrown round the ends of each bight. In order to render the knot more secure, the two bights may be seized as shown in Fig. 12 (*below*) or, alternatively, a piece of wood may be inserted in each bight.

A sheepshank is used for shortening a line temporarily without cutting it.

CATSPAW

A catspaw is formed by throwing back a bight in the line (Fig. 13, *left*) and then taking each of the two eyes so formed and twisting them separately outwards, away from one another, as shown by

the arrows. The two eyes (*a*) and (*b*) so formed (Fig. 13, *right*) are then brought together and slipped over the object to which it is

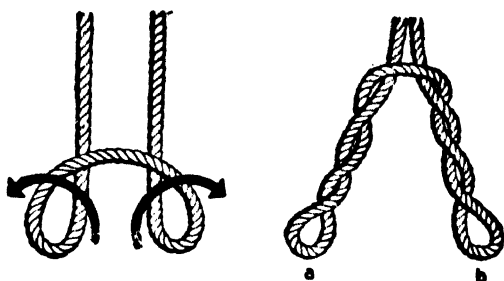


Fig. 13. Method of making a catspaw.

desired to secure the line. The catspaw is principally used for attaching a line to a hook.

BOWLINE

There are several methods of making a bowline, but the simplest and quickest is as follows: the standing part (*a*) of the line is held in the left hand, and the running end (*b*) in the right. The running end is then laid across the standing part (Fig. 14, *left*) and a half

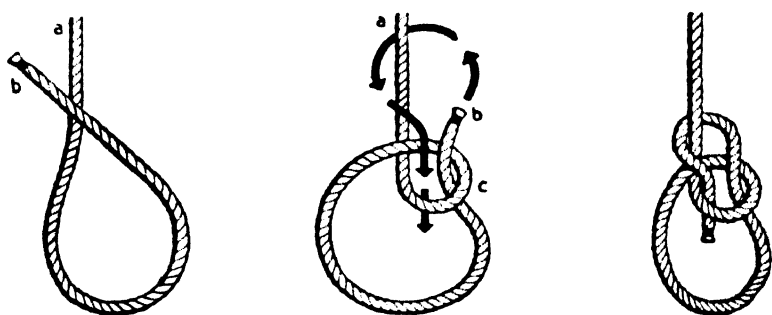


Fig. 14. Method of making a bowline.

hitch (*c*) formed round it by twisting the standing part with the right hand. The knot will then appear as shown in Fig. 14 (*centre*). The half hitch (*c*) is now secured against the standing part (*a*) by passing the running end (*b*) behind the standing part and back down through the half hitch (*c*) (Fig. 14, *right*). The knot is then drawn taut.

The bowline forms a non-slipping noose and is useful for lowering or raising purposes. It is also used to attach a line round the waist on those few occasions when it is necessary for a man to trail a line behind him.

RUNNING BOWLINE

A running bowline (Fig. 15) is made by forming a bight (*a*) in the end of the line and passing it under the standing part (*b*) (Fig. 15,

left). A bowline is then made with the end at the point (c) on the bight so formed (Fig. 15, *right*), thus making a running noose.

A running bowline can be put on a ring bolt, spar or other object, the ends of which are secured so that the noose cannot be slipped over, by passing the line round the object, leading it under the

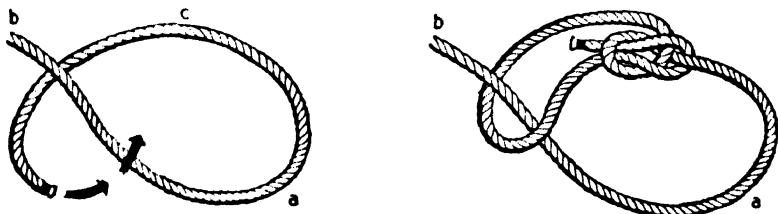


Fig. 15. Method of making a running bowline.

standing part and back, and then tying a bowline on the loop so formed.

BOWLINE ON THE BIGHT

A bowline on the bight is formed by first making a bight (a) (Fig. 16, *left*) in the end, or centre, of the line. This bight is then used in the same way as the free end is used when making an ordinary bowline, and a half hitch (b) (Fig. 16, *centre*) formed on the standing parts (c) of the line. The part of the bight (a) which has

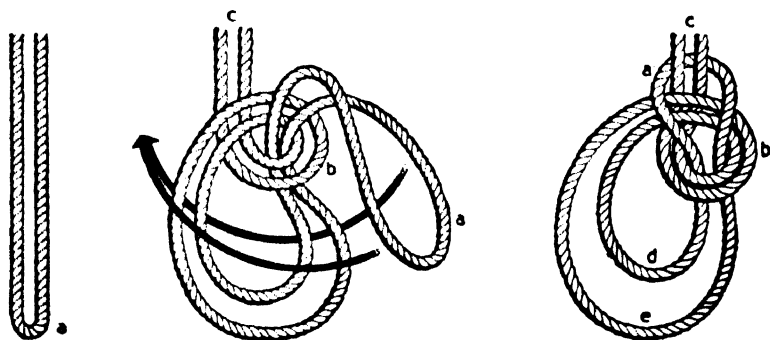


Fig. 16. Method of making a bowline on the bight.

been passed through the half hitch is then opened out, and taken in the direction indicated by the arrow (*i.e.*, behind the remainder of the knot) and brought up to the two standing parts (c). The knot is then hauled taut and will appear as shown in Fig. 16 (*right*).

This knot is used as a sling for rescue purposes. For this the two bights (d) and (e) which are formed (Fig. 16, *right*) are passed one under the knees and the other under the armpits of the person to be rescued. The knot should be so made that the loop to go round the body is somewhat smaller than the loop for the legs. The respective lengths can be adjusted as required by slackening the knot and pulling the loops to the desired size.

BLACKWALL HITCH

The Blackwall hitch (Fig. 17, *left*) is made by putting a half hitch over the shank of the hook in such a way that the free end is locked by the strain on the standing part. The hitch is used to make a rope fast to a hook for a short haul.

MIDSHIPMAN'S HITCH

The midshipman's hitch gives a more secure hold on a hook. It is begun in the same way as the Blackwall hitch, but the half hitch

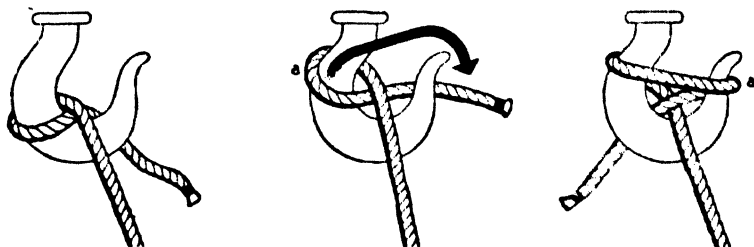


Fig. 17. Method of making (left) Blackwall hitch; (centre and right) midshipman's hitch.

is put well up on the shank of the hook (Fig. 17, *centre*). Part (a) of the hitch is then taken and placed over the bill of the hook (Fig. 17, *right*).

WATERMAN'S HITCH

The waterman's (sometimes called the lighterman's) hitch is made by taking several turns round a bollard or bitt, passing the running end over and under the standing part (Fig. 18, *left*) and then pulling out a bight (a) which is dropped over the bollard, thus forming a figure-of-eight (Fig. 18, *right*), and making taut.

The waterman's hitch is used in fireboat formations to secure a skiff to the towing bitt of a fireboat. Its virtue is that it can be both made and cast off when under a strain on the standing part.

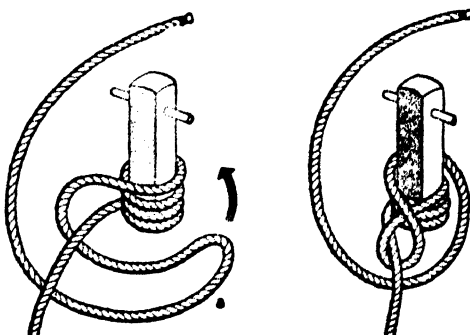


Fig. 18. Method of making a waterman's hitch.

CHAIR KNOT

The chair knot (Fig. 19) is formed by making two half hitches (a) and (b) (Fig. 19 *above, left*) on opposite sides of the rope, a portion of

each half hitch being then passed through the loop of the other. Part of loop (a) is grasped at (c) and drawn down through loop (b) and part of loop (b) is grasped at (d) and drawn up through loop (a). These parts are then pulled out to the required length to make the two "legs" of the knot and the knot is secured by throwing a half hitch round each bight.

There is an alternative method of making a chair knot, in which the half hitches are crossed before interlocking them, but this method is not so suitable for Fire Service work as that described above, since it results in a lock at the point (e). The chair knot is used for rescue purposes, and has, therefore, to be made with maximum speed. The length of the two bights has invariably to be adjusted, and if the knot is made with a lock at (e) this cannot be done without loosening it. Moreover, a chair knot made by either method cannot slip, since the half hitches round the bight hold it securely once it is

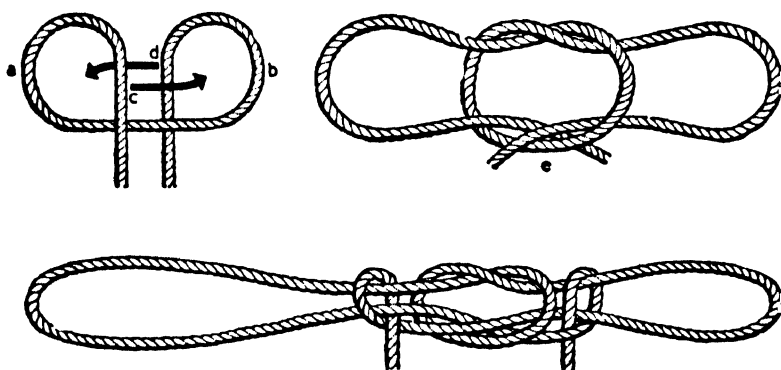


Fig. 19. Method of making a chair knot.

drawn tight, and there is thus no advantage to be gained from the additional lock at (e). The method shown, which enables the knot to be made and adjusted with the minimum of delay, is therefore to be preferred. The chair knot is commonly used for making a sling for rescue work when a lowering line with legs is not available, but a bowline on the bight is to be preferred. The two loops form the "hammock" in which the person to be rescued is slung, with one loop under the knees and the other under the armpits. The size of the two loops should be adjusted as necessary, bearing in mind the size of the person to be rescued. This is done by pulling more of the ends of the rope through the loop before the securing half hitches are tightened.

When the length of line permits, both a bowline on the bight and a chair knot are commonly made at the centre of the line. One half of the line is then used for lowering the person and the other part is thrown down to those below, to act as a guy line and so pull the person being lowered away from obstructions on his descent.

YACHTSMAN'S PURCHASE

The yachtman's purchase (Fig. 20) is used to strengthen two or more scaling ladders shipped together (except when they are being lowered or bridged, see Part 1, p. 111). The ladders are first mounted, one end of a long line being taken up. The end is secured to the top round of the top ladder by means of a clove hitch, and the line is brought down the front of the ladders, lying on the rounds. A bight (a) is then passed (from front to rear) between the top round of the bottom ladder and the bottom round of the ladder above it. This bight is passed down behind the bottom ladder and is brought out between the strings, below the bottom round. One arm is now put through the bight (a) thus formed and the bottom ladder is mounted to such a height that a knot can be made about halfway up the second ladder. A bight (b) of the standing part of the line is now pulled through the loop (a) (Fig. 20, *left*) and secured with a half hitch (c) made on the standing part, as if to form one half of a sheepshank (Fig. 20, *right*). Part (d) is then hauled on until the whole is tight, the slack being taken up on the running end (e). Two half hitches are then tied with a bight (f) of the end (e) round one of the strings of the bottom ladder, between the third and fourth rounds, and the ladder is then turned over, the knot having first been pulled to the side of the ladder to leave the rounds unobstructed.

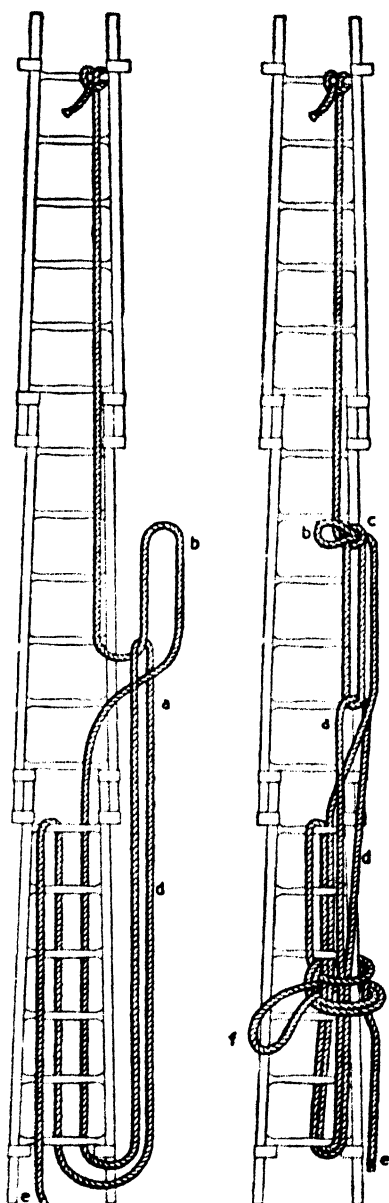


Fig. 20. Method of making a yachtman's purchase.

TURK'S HEAD KNOT

The Turk's head knot is an ornamental knot which can be made with a light line on a rope or spar for identification, as a hand-grip, or purely for ornamentation. Typical examples of its use are on the bell ropes of appliances, on the grasslines of fireboats and on the shorter leg of a lowering line (see Part 1, p. 123). The characteristic formation of this knot can be seen in Fig. 21 (viii) which shows a three-part Turk's head knot. It can be made with any number of parts up to nine, and is then known by the number of parts employed. A three-part Turk's head knot is, however, the one most commonly employed. It is made as follows :—

(i) A half hitch (*a*) and a turn (*b*), are first put round the spar or rope on which the knot is to be made (Fig. 21 (i)). (Although the

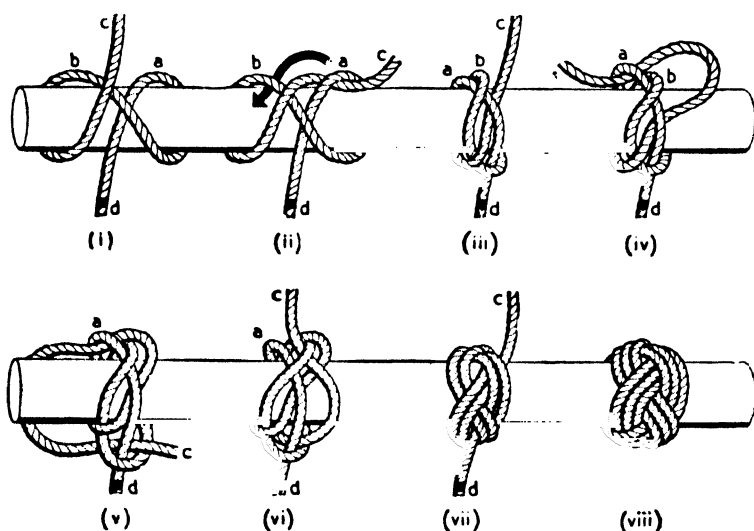


Fig. 21. Method of making a three-part Turk's head knot.

knot can be formed by working with both ends of the line, it will be found simpler to learn if the end (*d*) is kept short and the knot made up by working with the end (*c*) only.)

(ii) The end (*c*) of the turn (*b*) is then passed through the bight of the half hitch (*a*) (Fig. 21 (ii)).

(iii) The half hitch (*a*) is then passed under the bight of the turn (*b*). If the knot has been made correctly to this stage, the two ends will now lie parallel (Fig. 21 (iii)).

(iv) The end (*c*) is then passed through the bight of the half hitch (*a*), (Fig. 21 (iv)). The knot is now made and all that is necessary to complete it is to follow the lay round. Following round is begun by bringing the end (*c*) round behind the spar and passing it under the same turn (*a*) as that from which the other end (*d*) is emerging (Fig. 21 (v)).

(v) The end (c) is then passed over and under (Fig. 21 (vi) and (vii)) following the lay of the knot (*i.e.*, going over and under the same turns as strand (d)), until there are three complete lays of three strands each as shown in Fig. 21 (viii). The knot should then be worked taut and the ends cut off.

WHIPPING AND SEIZING

WHIPPING

When a rope is cut, the ends should always be whipped to prevent them unlaying. Whipping is carried out as follows: the end (a) (Fig. 22 (i)) of the twine to be used is doubled alongside the end of the line, and a half-dozen or so turns taken with the standing part round both the end (a) and the line (Fig. 22 (ii)). The twine is then formed into a loop (b) and the end (c) laid over the turns already taken (Fig. 22 (iii)). The loop is then used to continue the turns round the line and the two ends (a) and (c) of the twine. (Fig. 22 (iv)).

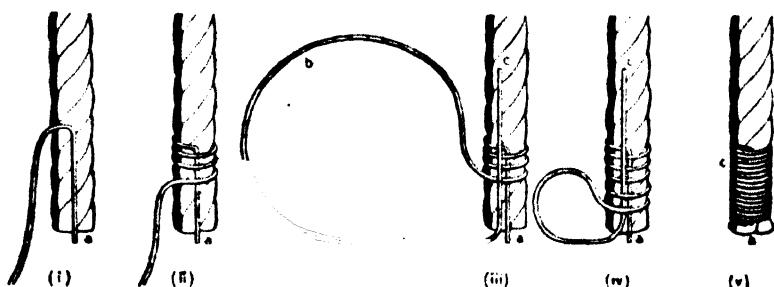


Fig. 22. Method of whipping the end of a line.

The turns are continued until as much as possible of the loop has been used up, and then pulled tight by means of the end (c). The protruding ends (a) and (c) of the twine are then cut off (Fig. 22 (v)).

If the end of the line is not accessible, as for example when a whipping is being put round a splice, the above method cannot be employed. In such circumstances the following method is employed. Whipping is commenced in the normal way as far as the stage shown in Fig. 22 (ii). A marlinespike or sliver of wood is then laid along the line and half a dozen more turns put on round both the line and the wood. The piece of wood is then removed and the end threaded through the turns. Each turn is then worked taut and both ends are pulled taut and cut off. This method can be followed in Fig. 23, which shows its use for seizing together two lines.

SEIZING

There are various methods of seizing but one easy and neat method is shown in Fig. 23.

A piece of twine is taken and laid doubled alongside the two lines to be seized (Fig. 23 (i)). Several turns are then taken round the two lines and also the end (a) as shown in Fig. 23 (ii) and tightened

by pulling on (a). A small piece of wood, a pencil, or any suitable object (b) is now inserted alongside the two ropes, as shown in Fig. 23 (ii), and several more turns are taken with the twine round the two ropes and the piece of wood in the same direction as before. When sufficient turns have been made, the wood is withdrawn and the end (c) threaded through the turns towards the centre (Fig. 23 (iii)) and, after tightening the turns to take up the slack caused by

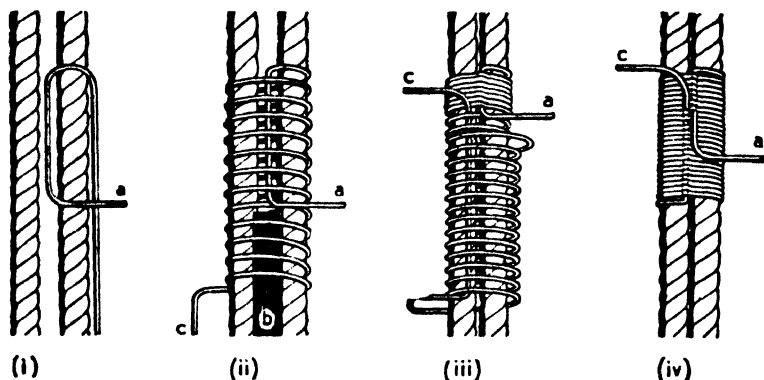


Fig. 23. Method of seizing two lines together.

withdrawing the piece of wood or pencil, pulled tight (Fig. 23 (iv)). The two ends (a) and (c) should now be tied with a reef knot and the surplus length cut off.

It should be noted that in Fig. 23 for the sake of clarity the two ropes have been shown apart. They must obviously be kept tightly bound together while the seizing is being carried out.

MOUSING

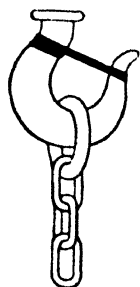


Fig. 24
Mousing on a
hook to prevent
a chain
coming adrift

Mousing consists of the securing of a piece of cord or wire across a hook after a line or chain has been attached to the hook (Fig. 24). This prevents the line or chain from jumping out if the weight should be temporarily removed. All hooks to which stays are attached, *e.g.*, on such appliances as escapes, should be moused.

SPLICING

Splices are used to join lines, to make an eye on the end of a line, or to make a firm end to a line, without the necessity for a knot, which is not only bulky, but often weakens the rope. Of the many possible splices the four following are the most commonly used.

EYE SPICE

To make an eye splice the end of the line should be unlaid for a short way, and bent round so as to form a loop of the required size. The

unlaid end should then be placed against the line so that the strands lie along it. The middle strand (a) should be taken under one of the strands of the standing part (Fig. 25 (i)) (which has previously been opened with a marlinespike), the tuck being made from right to left (with a right-hand lay) against the lay of the line. The left-hand strand (b) should then be tucked under the next strand of the line (Fig. 25 (ii)), also against the lay. The line should then be turned round to the left, in order to bring the right-hand strand (c) on top, and the latter should be tucked from right to left under the strand immediately to the right of that under which was passed the middle strand (a) (Fig. 25 (iii)). The splice is now started, one tucked strand coming out between each strand of the line, and the three strands (a), (b) and (c) should be drawn taut so that the formation of the splice can be more easily followed. Each strand should then be tucked over one strand of the standing part of the line and

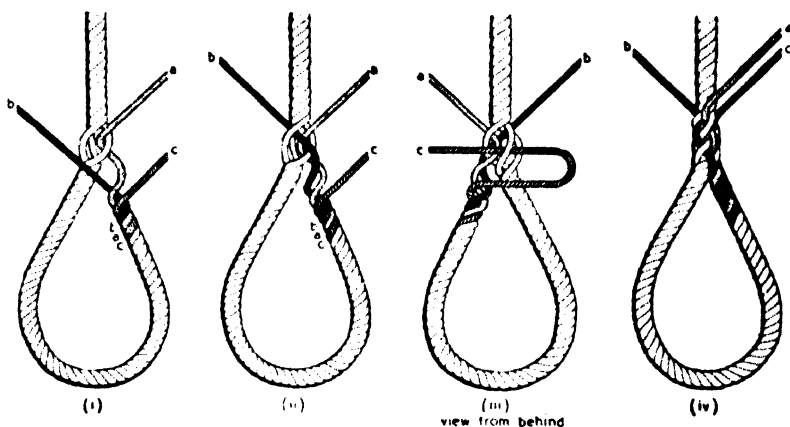


Fig. 25. Method of making an eye splice.

under the next, always working against the lay (Fig. 25 (iv)). At least three tucks should be given to each strand if the splice is to be sound.

In order to make a neat splice, the strands are then halved and used to make the fourth tuck; they are then halved again for the fifth tuck, after which the ends may be cut off.

SHORT SPLICE

The short and long splices are used to join two lines together, the former when there is no necessity for the line to pass through a block, the latter when little enlargement of the diameter of the line can be allowed.

To make a short splice the running ends of the lines are unlaid to the required distance and clutched together as in Fig. 26 (i), so that the strands of the one line lie alternately between those of the other (i.e., so that one strand of each line lies between two strands of the other). The strands of line (a) are then tucked into those

of line (b) in the same way as for the eye splice and those of line (b) into line (a), working all the time against the lay of the rope.

Although the short splice can be made simply and quickly once its method of construction is understood, difficulty is often experienced, when learning the knot, in beginning the splice, owing

to the number of loose ends. The best method of overcoming this difficulty is to hold strands (c), (d) and (e) of line (a) in the palm of the right hand firmly against line (b) while strands (f), (g) and (h) are being tucked into (a). Alternatively, a piece of twine may be lashed round the fork to hold the strands in place.

This tucking is begun as follows (Fig. 26 (ii)) : strand (g) is first brought down over strand (e) and under strand (d) so that it emerges between (c) and (d). Strand (f) is then tucked under (e) so that it emerges between (d) and (e), and finally strand (h) is tucked under (c). If the splice has been correctly made to this point no difficulty should be experienced in tucking strands (c), (d) and (e) into line (b) (Fig. 26 (iii)). The splice is now firmly started and can be

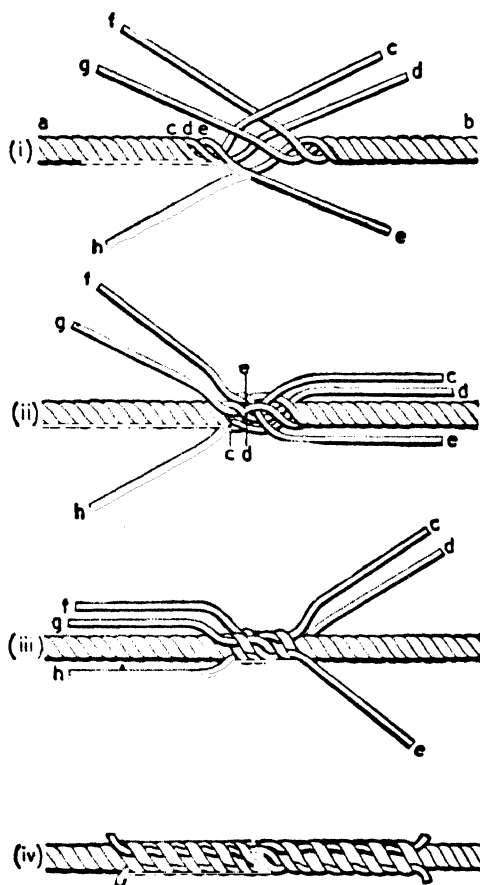


Fig. 26. Method of making a short splice.

drawn up tight before proceeding. Three or four tucks (Fig. 26 (iv)) should be made in each direction, the strands being reduced for the final tuck, after which the ends are cut off.

LONG SPLICE

To make a long splice (Fig. 27) the ends of the two lines should be unlaidd to a distance of some twelve times their circumference, and clutched together as if to begin a short splice (Fig. 27 (i)). One

strand (a) of the first line should then be unlaid for a distance slightly less than the length of the strands clutched in from the second line and the gap thus caused filled up by twisting in the strand (b) of the second line which lies opposite to it (Fig. 27 (ii)). Strand (c) of the second line should then be unlaid and replaced by strand (d) of the first line, the third pair of strands (e) and (f) being left in position (Fig. 27 (iii)). The strands making up each pair should then be halved, and tied in an overhand knot, in order to fill the

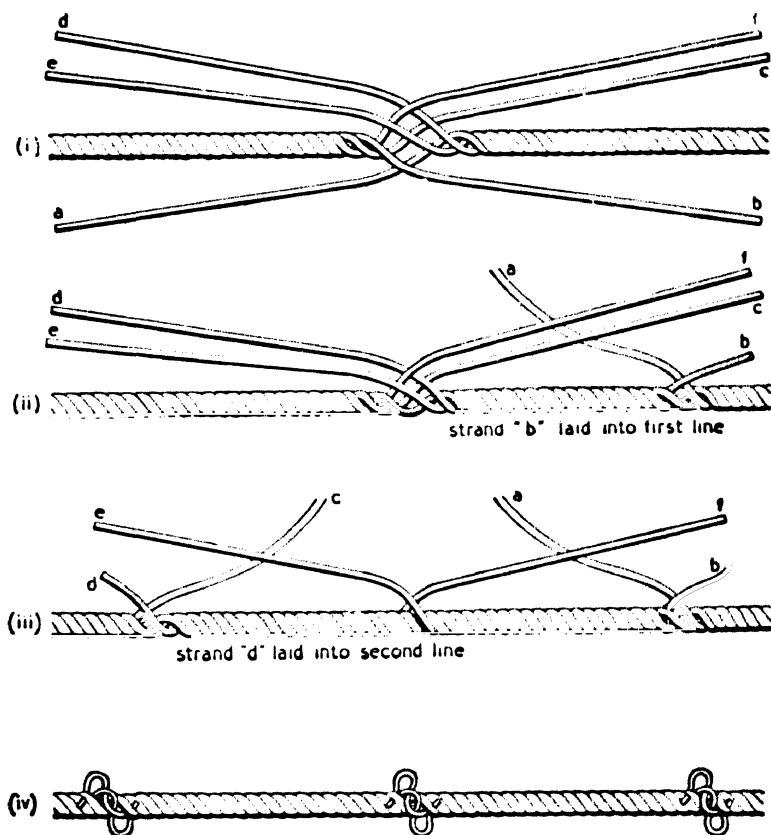


Fig. 27. Method of making a long splice.

vacant space in the lay of the strands (Fig. 27 (iv)). After tying the knot, the ends should then be taken over one strand and under the next one on each side of the knot, cut off, and the whole splice shaped and hardened. Both short and long splices can be hardened, and improved in appearance, by dressing down with a marlinespike or mallet or by rolling them, either between the palms or on the ground beneath the ball of the foot.

BACK SPLICE

A back splice is made by first crowning the line and then tucking each strand back down the line over and under, against the lay, as in an eye splice. The crown knot with which the splice is commenced is made by first forming a bight in the middle strand (*a*) so that it lies between the other two strands (Fig. 28 (i)). The third strand (*b*) is then formed into a bight so that it lies in front of (*a*) but behind the first strand (*c*) (Fig. 28 (ii)); and finally the first strand (*c*) is passed behind (*b*) and through the bight of (*a*) (Fig. 28 (iii)). The knot should then be drawn taut and each strand

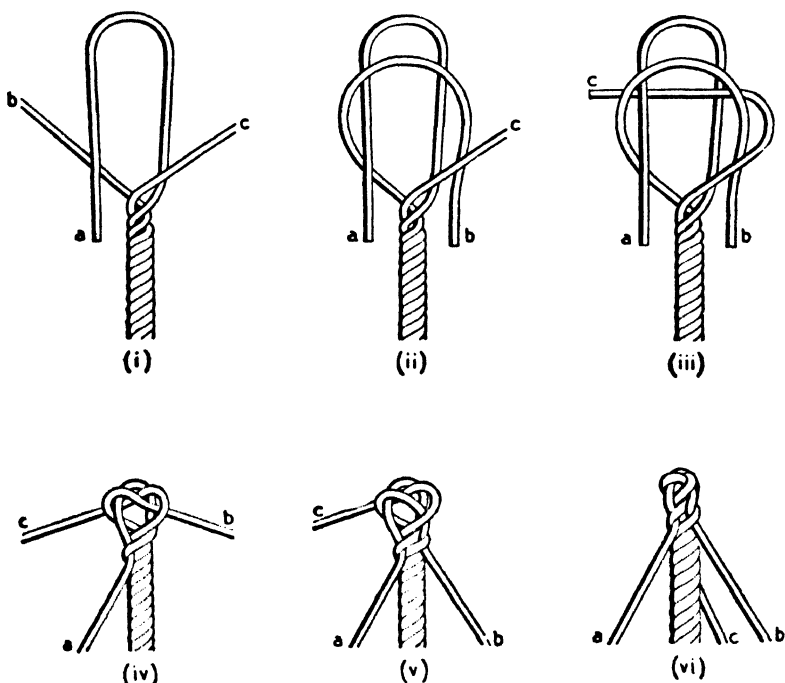


Fig. 28. Method of making a back splice.

laid back into the line over and under against the lay. The tucking of the first two strands is shown in Fig. 28 (iv) and (v), and Fig. 28 (vi) shows the splice as it appears when the first tuck is completed, with the crown knot drawn taut.

By the use of splicing, a long line can be transformed quite simply into a lowering line with running eyes (see Part 1, p. 123), and if this is done it will overcome the necessity for making a knot at the time of the rescue. It is not always easy to make a good chair knot in darkness and with an excitable and possibly panicky person beside one. The method is as follows :—

(i) An eye splice should be made at one end of the line to form a running eye and the standing part passed through it to form a bight.

(ii) An additional 7 ft. of sound line (which can be taken from the sound part of a condemned long or short line) should be procured and an eye splice made in one end, the other end being then passed through this eye to form a bight.

(iii) The additional 7 ft. of line should then be spliced in the same way as an eye splice into the long line, about 6 ft. from the end on which the running eye was made.

(iv) A Turk's head knot should be made on the shorter leg, *i.e.*, the original line (see Part 1, p. 123).

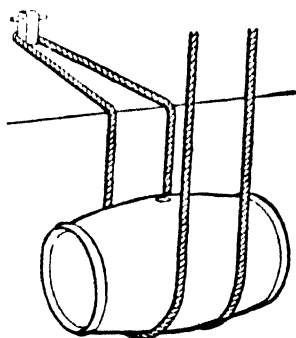
(v) All splices should then be hardened and served with stout twine as a protection against fraying.

SLINGS

Lines are extensively employed in salvage work for moving heavy objects, either by means of various types of sling, or more rarely with pulley blocks to form purchases, which latter method also necessitates the use of slings to secure the object to be moved.

PARBUCKLE

A parbuckle for lowering a cask or similar shaped article is formed by placing the bight of a line over a secure object and then passing the two ends under the two quarters of the cask and back again over it (Fig. 29, *above*). By paying out or hauling in the two ends of the line, it may then be used to lower or raise the cask as desired. The two parts of the line must always be paid out or hauled in equally, in order to prevent the cask slipping out of the sling.



SLINGING A CASK

(a) *On Its Side.* To sling a cask on its side a running bowline (a) is made at the end of the line (Fig. 29, *below*) and the loop so formed placed over one end of the cask and hauled taut. The end of the rope is then taken around the other end of the cask and clove hitched to its own part (b). A hook or another line can then be attached at (c) to the sling thus formed.

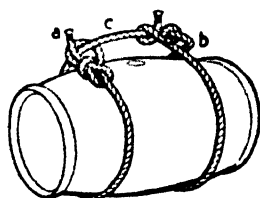


Fig. 29. Above: use of a parbuckle to hoist a cask. Below: body sling method of hoisting a cask.

When slinging a cask on its side the bung should be kept uppermost.

(b) *Upright.* To sling a cask upright the cask is placed on end and the end of a line passed under the centre (Fig. 30, *left*). An overhand knot is then formed with both ends of the line on the top

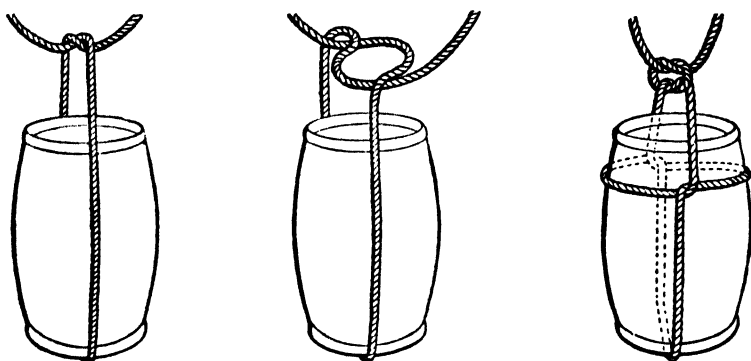


Fig. 30. Bale sling method of holsting a cask.

of the cask, opened out (Fig. 30, *centre*), and the bight passed over the head of the cask and hauled taut, the ends being tied above the cask by a reef knot (Fig. 30, *right*).

BLOCKS AND TACKLE (PURCHASES)

A tackle is an arrangement of blocks and lines to enable a man to lift a greater weight than he can with his own unaided effort, by applying one of the fundamental principles in mechanics, that a small force operating over a considerable distance can be used to move a large weight over a short distance. There may be occasions when the fireman will find it necessary to have some knowledge of purchases, blocks and tackle. This will apply particularly in the case of the fireman afloat.

BLOCKS

Blocks are formed of wood or metal and the various individual parts are as follows (Fig. 31) :—

Shell. The case containing the sheave.

Sheave. The wheel upon which the line travels.

Bush. The metal centre of the sheave which, in patent sheaves, contains metal rollers and consequently works more easily than those with a plain bearing.

Pin. The shaft upon which the sheave revolves. It is made of steel and has one end enlarged so as to prevent it passing completely through the block.

Swallow. The open part of the shell into which the sheave fits.

Crown. The part of the block at the top where the hook is placed. It can be identified (on blocks fitted with a strop) by the shallowness of the score.

Score. The grooves in the shell which enable the strop to grip the shell tightly.

Tail. The base of the block. On a wooden block it can be identified by the deeper score, which takes the splice of the strop.

Strop. The rope or wire by which the hook is secured to the block. Some types of block are fitted with a double strop.

Hook. A hook is seized on a thimble into the strop above the crown of the block, so that it can be made fast to an object. Blocks are also used either with an eye seized into the strop in place of the hook (Fig. 33, *left*) or with the strop terminating in a loose end (Fig. 34, *left*) which can be made fast to a spar or other line. The hook of a block is always secured to its crown, but some types of block (known as tail blocks) have also an eye seized into the strop below the tail (Fig. 34, *left*).

The size of a block is measured by the length of the outside of the shell and, when using a hemp or manila line, which is, of course, measured by its circumference, the block should be three times the size of the line. Thus for a 3-in. line a 9-in. block should be used. A line rove through blocks is called a fall, the running end of the fall being the loose end, and the standing part the fixed end.

The types of block most commonly employed are fitted with either one or two sheaves, being then known as single and double blocks respectively, but threefold blocks (*i.e.*, having three sheaves) are sometimes employed. There are also many and various patent blocks in use, the majority of which are self-lubricating. A special type, which has an opening in the shell to permit a rope

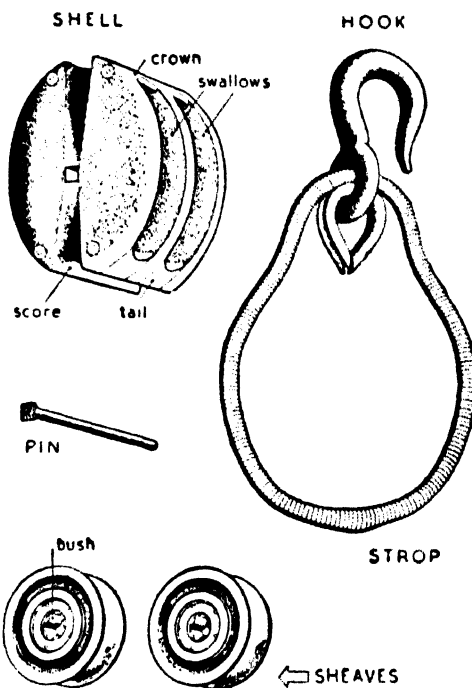


Fig. 31. Sketch showing the various parts of a block.

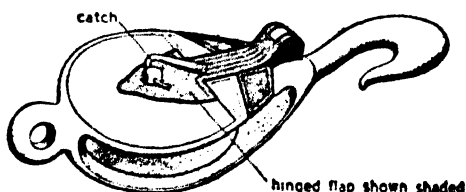


Fig. 32. Typical snatch block.

to be inserted without reeving the end through, is the snatch block such as is sometimes used on turntable ladders in conjunction with the life line, and also on fireboats in conjunction with an endless whip (see Chapter 47). These blocks usually have a hinged flap which must be securely clamped down and fixed before use, a catch (Fig. 32) being provided for this purpose. When the block is required, the catch is released and the hinged flap lifted, the line being then inserted in the portion of the swallow which is thus exposed.

TACKLE

There are several different types of tackle, the particular arrangement of blocks to be employed being dependent upon the weight

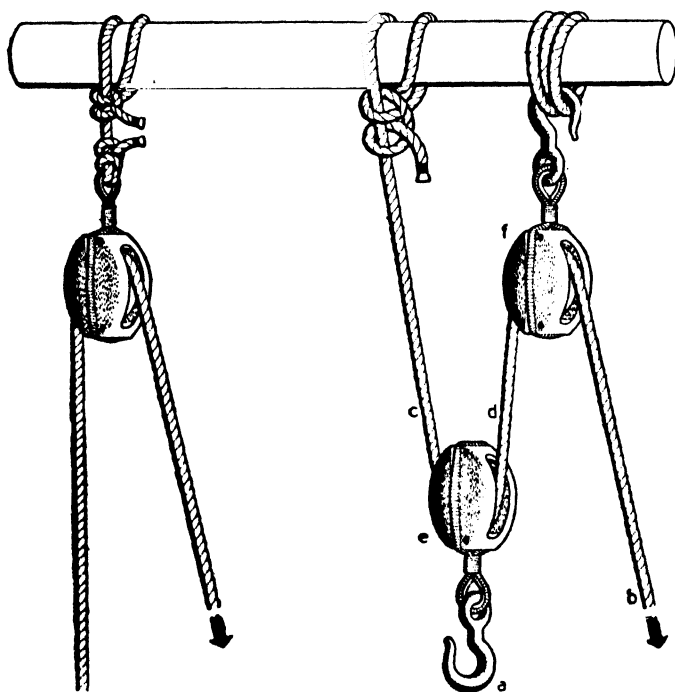


Fig. 33. Use of blocks. Left : single whip (no gain in power). Right : double whip (two times power).

which is to be lifted but, for normal Fire Service purposes, a single whip or a double whip should prove suitable.

The simplest method of raising a weight by means of a block and line is to reeve the line through a single block, attach one end to the weight and haul on the other. This is known as a single whip (Fig. 33, left) and it can be seen that the force which it is necessary to exert is equal to the weight to be lifted. There is thus no mechanical advantage (see below), but there is a considerable gain

in ease of working. One example of its use is for hauling up hose in hose towers.

When the weight is too great to be lifted by this means, it is necessary to introduce additional blocks, the purpose of which is to increase the distance through which the lifting force is applied in relation to the travel of the load. The ratio of these two distances is termed the mechanical advantage or simply the advantage of the system. Thus with a double whip (Fig. 33, *right*) for example, which consists of two single blocks, there is an advantage of two, since a weight attached to the hook (*a*) will be raised only 6 ins. for a movement of 1 ft. on the line (*b*). If the diagram is carefully examined it will be seen that when the line (*b*) is hauled for a distance of 1 ft. the lines (*c*) and (*d*) each shorten by 6 ins. respectively, thus raising the moving block (*e*) by 6 ins. only. The block (*f*) in this particular tackle does not increase the advantage, but merely alters the direction in which the line (*b*) is hauled.

It will thus be seen that the introduction of the two moving parts (*c*) and (*d*) of the line doubles the weight which can be lifted.

It follows, therefore, that the advantage given by a particular tackle can be calculated by counting the number of parts in or attached to the moving block. Thus, in a luff tackle (Fig. 34, *left*) consisting of one single and one double block, it will be seen that there are three parts (*a*), (*b*) and (*c*) attached to the moving block (*d*), each of which will shorten 4 ins. only for a movement of 1 ft. on the line (*f*), and the advantage is, therefore, three times. If, on the other hand, the block (*d*) were fixed and the weight attached to the

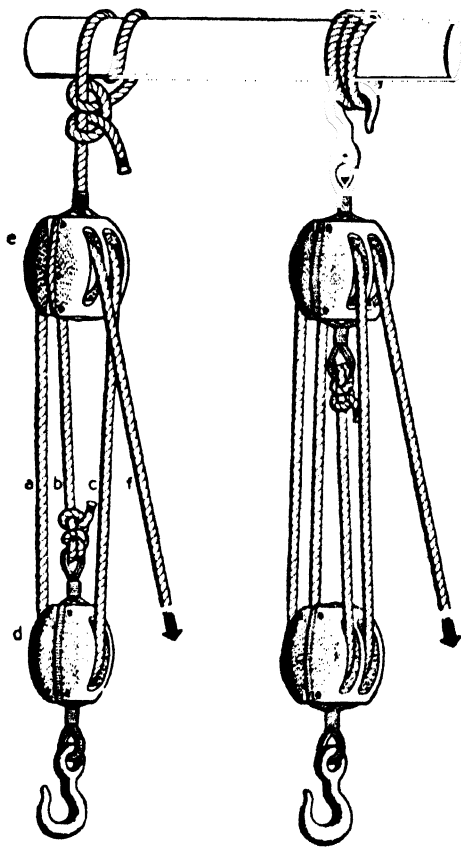


Fig. 34. Use of blocks. Left : luff tackle (three times power). Right : double luff tackle (four times power).

block (e) (which would thus become the moving block), there would then be four parts, (a), (b), (c) and (f) in the moving block and the advantage would be four times. Similarly, with a double luff tackle (Fig. 34, *right*) consisting of two double blocks, the advantage is four or five, according to which is the moving block. With the tackle rove in the manner shown in Fig. 34 (*right*) the advantage is four.

It will be seen that the manner in which a tackle is rove is of practical importance, and if an alternative is possible the position of maximum advantage should always be employed. The manner in which a tackle is rove is, however, conditioned by the lead of the loose end of the fall (*i.e.*, by whether the object to be moved is being drawn *towards* the person hauling, in which case the fall leads from the moving block, or *away* from him, in which case it leads from the fixed block), and since the commonest use of tackle is for raising heavy objects, this must usually lead from the fixed block, although this position gives the lesser advantage.

Before a tackle is rove the blocks should be examined to ensure that they are well lubricated and free from dirt or grit. The strops, blocks and falls must be in good condition, the pins made fast and the standing end of the fall secure. The fall must, of course, always be free from kinks. When hauling, and the fall is taut, the load should be hauled steadily and not jerked. The fall should always lie in a straight line with the sheaves, thus avoiding any damage to the fall or any strain where the tackle is attached. A haul in a straight line with the sheave will ensure the smooth running of the falls. All hooks or shackles of tackles should be moused to prevent them becoming unshipped. When lowering, the line should never be allowed to run through the hands but always paid out hand over hand or a turn taken round some secure object.

When setting up a purchase a pole should be erected horizontally about 6 ft. from the ground and be supported at each end on sheer legs (see Part 3, p. 113). This should suffice for normal circumstances, but in each individual case the varying conditions and equipment available will have to be considered.

MAKING UP LINES

It is essential that lowering and long lines should be neatly and securely made up for carrying, yet they must be instantly available for use when required. It is important, also, that the line should pay out freely when cast down or pulled out, and that the line when made up should be convenient for carrying up a ladder, and have no loose ends to become entangled in the rounds. Three of the methods which have been employed for this purpose are described below. None of these is entirely satisfactory and the perfect method remains to be invented.

FIGURE-OF-EIGHT

A line is made up in figure-of-eight by holding one end of the line in the right hand and then holding the hands a suitable distance

apart and laying the rope over and under each hand in turn (Fig. 35, *above*). This operation is easier if carried out by two men, but can be done single-handed quite simply, by dipping each hand under the line in turn. The line is secured when made up by putting a clove hitch (Fig. 35, *below*) round the centre of the figure-of-eight. This method (which is that most commonly employed in the Fire Service) is simple, quick and undoubtedly the best for making up lines on the fireground, but it has the disadvantage that the line soon becomes loose, and is liable to become entangled with other gear in the appliance locker unless stowed separately. It is, moreover, not very convenient for carrying when mounting

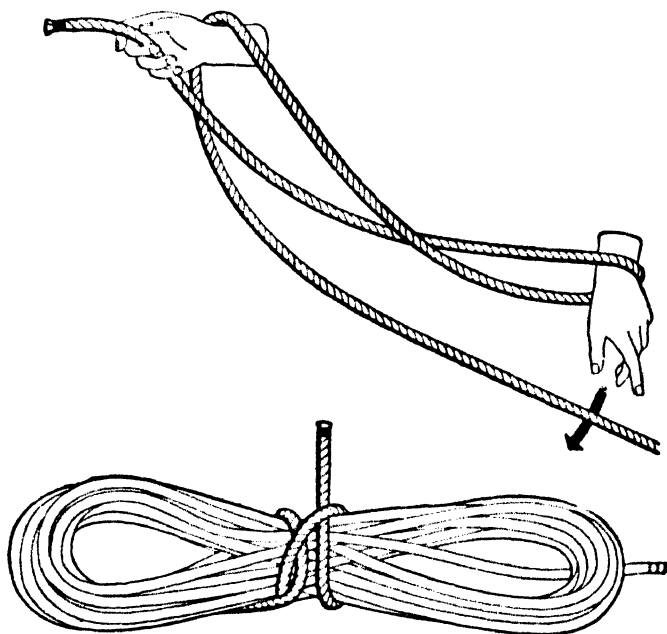


Fig. 35. Method of making up a line by means of a figure-of-eight knot.

a ladder, since, if the figure-of-eight is made large enough for it to slip over the shoulder, the made-up line becomes long and bulky and cases have been reported of its being caught in the rounds, particularly those of turntable ladders. If a tidy stow is desired a line made up in figure-of-eight can be kept in place as follows :—

The line is first made up as described above, except that 3 or 4 ft. of spare line is left at the beginning. Bights (a) and (b) (Fig. 36, *above*) are then made with each end of the line and passed through the adjacent loop of the figure-of-eight. The two ends (c) and (d) are then passed through the bights and tied in a reef knot (Fig. 36, *below*).

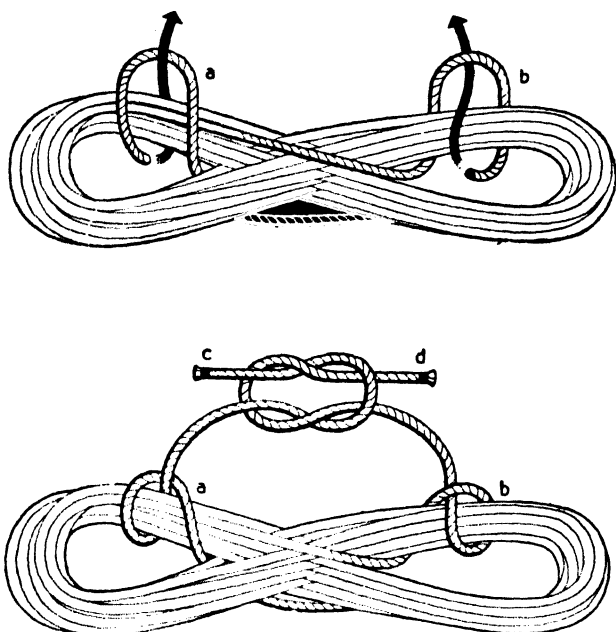


Fig. 36. One method of securing a line made up in a figure-of-eight.

AMERICAN ROPE COIL

This method, which is used in all the principal American Fire Brigades, is entirely satisfactory from the point of view of carrying and paying out, but has the disadvantage that a bollard is necessary to enable the line to be made up satisfactorily. A simple bollard for this purpose, which can be constructed without difficulty, is shown in Fig. 37. The method of making up is as follows:—

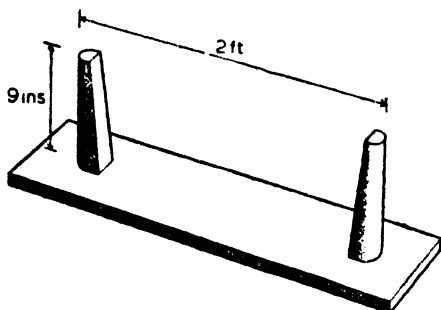


Fig. 37. Simply constructed wooden bollard for use when making up a line on the method shown in Fig. 38.

The line is first coiled on to the bollard (Fig. 38 (i)) leaving the end (*a*) clear, and sufficient line on the other end to wind round the coils almost from end to end. For a 100-ft. line it will be sufficient if eleven coils are put on, the last five coils being laid outside the first six (Fig. 38 (ii)).

The coils are then removed from the bollard and the running end

is passed round them, the second turn (b) locking the first (c) (Fig. 38 (iii)). This operation should be begun at that end of the coil from which the end (a) protrudes. When the coil has been completely wrapped, small loops (d) and (e) will be left at each end (Fig. 38 (iv)).

The remainder of the line is then doubled back upon itself to form a bight (f) which is first pushed through loop (d) and then through loop (e) (Fig. 38 (v)) leaving a small bight (g) projecting. The end of the line (h) is doubled back on itself and passed through bight (g) which is then drawn tight, thus locking the end (h).

The principal advantage of this method of making up a line is that two loops (j) and (k) are formed which can be utilised for carrying purposes. For this they are opened out and slipped over the shoulders like the straps of a rucksack and the roll is carried on the back, leaving both hands free. Although the roll is secure it is not tied and can easily be freed by pulling on the end (h). When the line is required for use, the end (h) is freed, the loops (j) and (k) pulled out, the free end (a) held and the roll thrown down. Provided the line

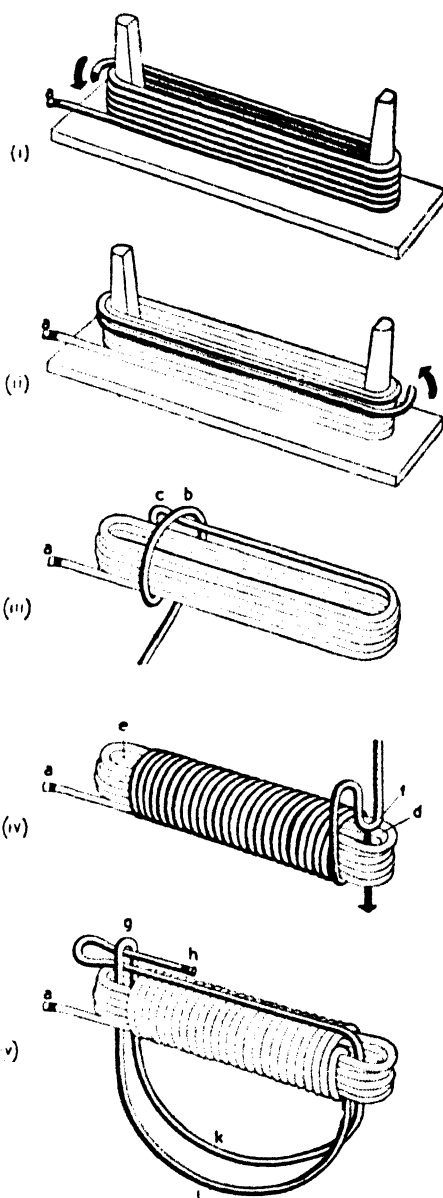


Fig. 38. American rope coil method of making up a line.

is correctly made up it will pay out smoothly from the roll and will not tangle on falling.

CHAIN COIL

This coil is simple to make and pays out freely, but the line when made up is not so convenient for carrying as when made up by the method described above.

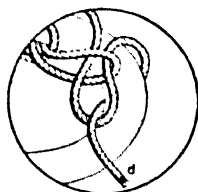
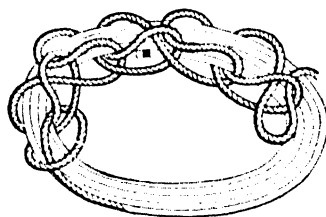
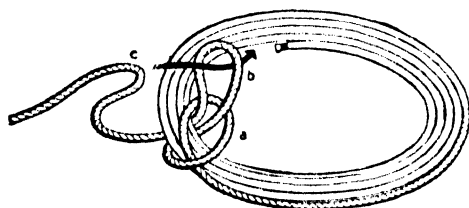
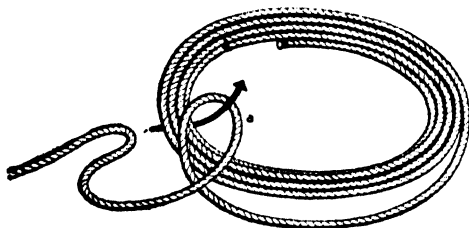


Fig. 39. Chain coil method of making up a line.

A circular coil, about 18 ins. diameter, is laid on the ground. For a 100-ft. line five turns should be made. A half hitch (a) is then laid over the top of the coil (Fig. 39, *above*) and a bight (b) is formed in the line and taken under the coil and through the half hitch (a). The bight (b) is then laid over the coil and another bight (c) formed in the line and taken over the coil and through (b) (Fig. 39, *centre*). This operation is continued, the bights being pulled through alternately over and under the coil as shown in Fig. 39 (*below*), until all the line has been used, if necessary laying a second series of bights on top of the first. The line is then made fast by pulling the end (d) through the last bight (Fig. 39, *inset*). To uncoil the line, the end (d) is pulled back through the bight and held.

If the line is then cast down or pulled out it will pay out smoothly and freely.

BLOOD KNOT

Belt lines should be made up in a blood knot (Fig. 40), the object of which is to make up a line in such a form that whilst it is quite

firm, it is not tied and can be easily and quickly released when required, and the loop provided can be used to secure the line to a fireman's belt. Neatness and correctness in making this knot can only be achieved by each individual fireman experimenting with his own line, as belt lines are of varying lengths.

A loop (a) about 7 ins. long is made at one end of the line (Fig. 40, *left*) or, if an eye splice is fitted, this may be employed. With the remainder of the line a

coil (b) is now made, the same length as the loop, leaving spare a length of line (c) sufficient to bind the whole coil. The coil (b) is now bound with the line (c). After approximately half the coil has been bound in this way (Fig. 40, *centre*) the loop (a) is folded back down on the coil and the binding continued (Fig. 40, *right*) round both the coil and the loop until the end is nearly reached. If the length of the line (c) has been accurately calculated a short length (d) should be left which is doubled back on itself and pushed through the loop (e) at the end of the coil. The knot is then tightened from

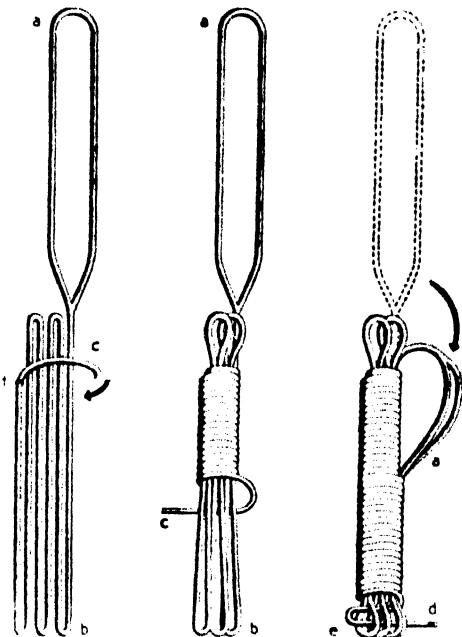


Fig. 40. Method of making up a belt line by means of a blood knot.

the opposite end by pulling tightly on the visible portion of loop (a), the other end of the loop thus clamping the end (d).

To release the knot it is merely necessary to pull out the end (d) and the line will then pay out.

It is necessary to practise this knot carefully so as to be able to estimate how much free end must be left for binding after the completion of the coil. It is helpful to mark the line with a coloured cotton, shown at (f) in Fig. 40 (*left*), when the correct length has been found.

CORRIGENDA LIST FOR PARTS 1, 2 AND 3

The following amendments should be made to the text of Parts 1, 2 and 3 :—

PART 1.

Page vii, Chapter 7, "Ropes and Lines," for " 35 " read " 39."

- „ 103. Line 25. In the standard test for an extension ladder it is laid down that after the ladder has been extended across two trestles the weight of one man shall be gradually applied. No method is laid down in the text as to how he shall sit, although he is shown sitting sideways in Fig. 3. In practice it has been found that unless the weight is carefully applied there is a tendency to stress one string more severely than the other and thus subject the ladder to a strain for which it was not designed. The test should therefore be carried out with the man sitting astride the ladder and applying his weight gradually. A note to the effect that the man should straddle the ladder should be made on Fig. 3.
- „ 119. Line 40, delete " Rope . . . W.C.2," and substitute " Hard Fibre and Cordage Federation, Portland House, 73, Basinghall Street, London, E.C.2."

PART 2.

Page 141. Line 18, for " possible " read " permissible."

- „ 143. Caption to Fig. 23. Insert " Merryweather " before " 100-ft."
- „ 168. Line 23 and footnote. Delete " grab hook " and substitute " salving hook."
- „ 172. Line 37, for " 45 " read " 46 ".
- „ 175. Line 27, for " 45 and 46 " read " 46 and 47 ".

PART 3.

Page 39. Line 7, delete the paragraph beginning " Under Regulation . . ." to ". . . National Fire Service expenditure " and substitute the following :—

" Under Regulation 14 (3) of the National Fire Service (General) Regulations, 1944, the local authority continues, during the emergency period, to carry out its functions under Section 3 of the Fire Brigades Act, 1938, subject to any direction given by the Regional Commissioner."

A useful formula to remember to assist in tying the knot correctly is "Right over left and under, left over right and under."

A reef knot lies very neatly and flat and should always be used when a common tie is required. The free ends of the lines lie parallel, making it easily distinguishable from a granny knot which is a dangerous knot in which they tend to lie at right angles. The

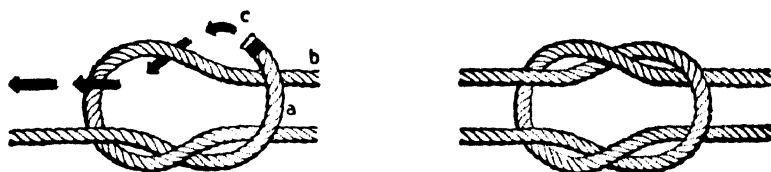


Fig. 2. Method of making a reef knot.

main use of a reef knot is to join together two ropes or lines of equal thickness.

It is quickly untied and is a useful knot for Fire Service and general purposes.

CLOVE HITCH

A clove hitch (Fig. 3, *left*) consists of two half hitches, one of which is reversed. By passing over one another the parts of the line bind

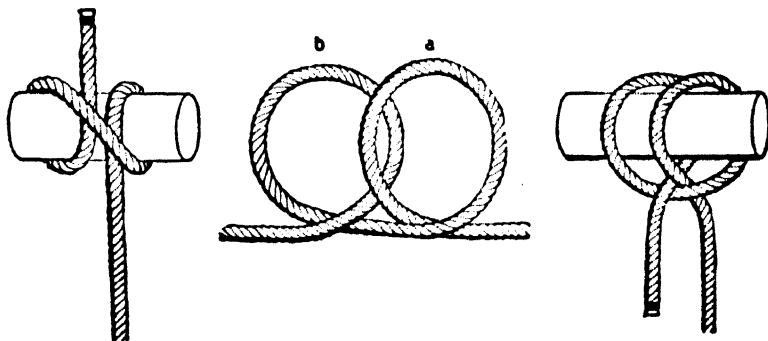


Fig. 3. Method of making a clove hitch. Left : on a rope or spar. Centre and right : by means of two locking half hitches slipped over an object or spar.

and form a secure hitch which is easily untied but which will not slip under a steady direct strain. It will slip if subjected to a sideways pull and when this may be encountered a rolling hitch (see later) should be employed.

A clove hitch can also be made in the middle of the line, without using the ends, in the following way. At the desired part of the line two half hitches are made (Fig. 3, *centre*) by twice passing the rope held in the right hand below that held in the left hand. Half hitch (a) is now laid on top of half hitch (b) and the double bight so formed can be slipped over the end of any suitable object, the two

half hitches then closing together to form a clove hitch (Fig. 3, *right*).

The clove hitch is used for making a line fast to a spar, or for securing a line to any object such as a pump suction.

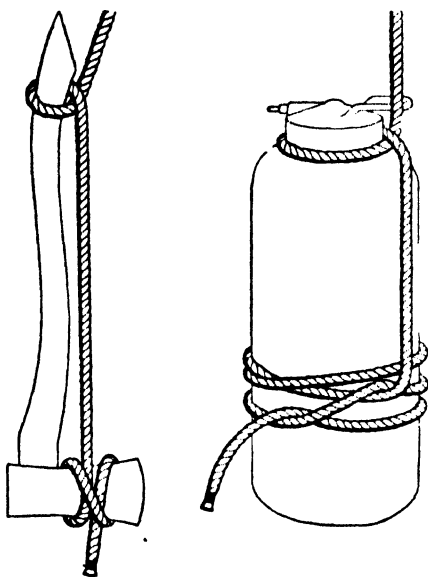


Fig. 4. Left : method of hoisting an axe using a clove hitch on the head and half hitch on the haft. Right : method of hoisting an extinguisher using a rolling hitch and half hitch.

Apart from its use for making a line fast, the clove hitch can be used for hoisting many items of Fire Service equipment. When these must be kept in a vertical position a clove hitch is usually made on the lower part of the object and a half hitch on the upper part. It is one of the most important and useful knots in Fire Service work and is extensively used.

Illustrations of its use are given in Fig. 4 (*left*) and Fig. 6 (*left*).

ROLLING HITCH

The rolling hitch (Fig. 5) is a variant of the clove hitch and is commenced and finished in the same manner, but there is an intermediate round turn between the two half hitches. It should be noted that this intermediate round turn passes over the standing part.

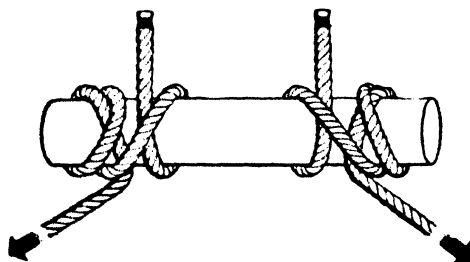


Fig. 5. Method of making a rolling hitch.

This knot has the advantage that it will not slip in the direction in which the double turn is applied if it is subjected to a sideways pull. When tying a rolling hitch, therefore, it must be constructed for the specific strain which it is to resist. Rolling hitches made to take the strain to the left and to the right are shown in Fig. 5 (*left*) and (*right*) respectively. No difficulty should be experienced in tying the knot correctly if it is remembered that the round turn should be made on the same side of the standing part as that on

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